I-10/SR 85 CORRIDOR PROFILE STUDY

CALIFORNIA STATE LINE TO INTERSTATE 8

ADOT WORK TASK NO. MPD-043-15
ADOT CONTRACT NO. DT11-013164

Draft Working Paper 4: Performance-Based Needs Assessment

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PREPARED FOR:

Arizona Department of Transportation

PREPARED BY:

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LIST OF ABBREVIATIONS & ACRONYMS

ABBREVIATION	NAME
ADOT	Arizona Department of Transportation
AZTDM	Arizona Travel Demand Model
BQAZ	Building a Quality Arizona
DMS	Dynamic Message Sign
HCRS	Highway Condition Reporting System
HPMS	Highway Performance Monitoring System
LOS	Level of Service
MP	Milepost
MPD	Multimodal Planning Division
I	Interstate
LRTP	Long-Range Transportation Plan
PeCoS	ADOT Maintenance Performance Control System
POE	Port of Entry
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
P2P Link	Planning to Programming Linkages
SHSP	Strategic Highway Safety Plan
SR	State Route
TTI	Travel Time Index
TPTI	Truck Planning Time Index
TTTI	Truck Travel Time Index
V/C	Volume-to-Capacity

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study of Interstate 10 (I-10) and State Route 85 (SR 85) between the California State Line and Interstate 8 (I-8). This study will look at key performance measures relative to the I-10/SR 85 corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

The intent of the corridor profile program, and of the Planning to Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting eleven corridor profile studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, includes:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

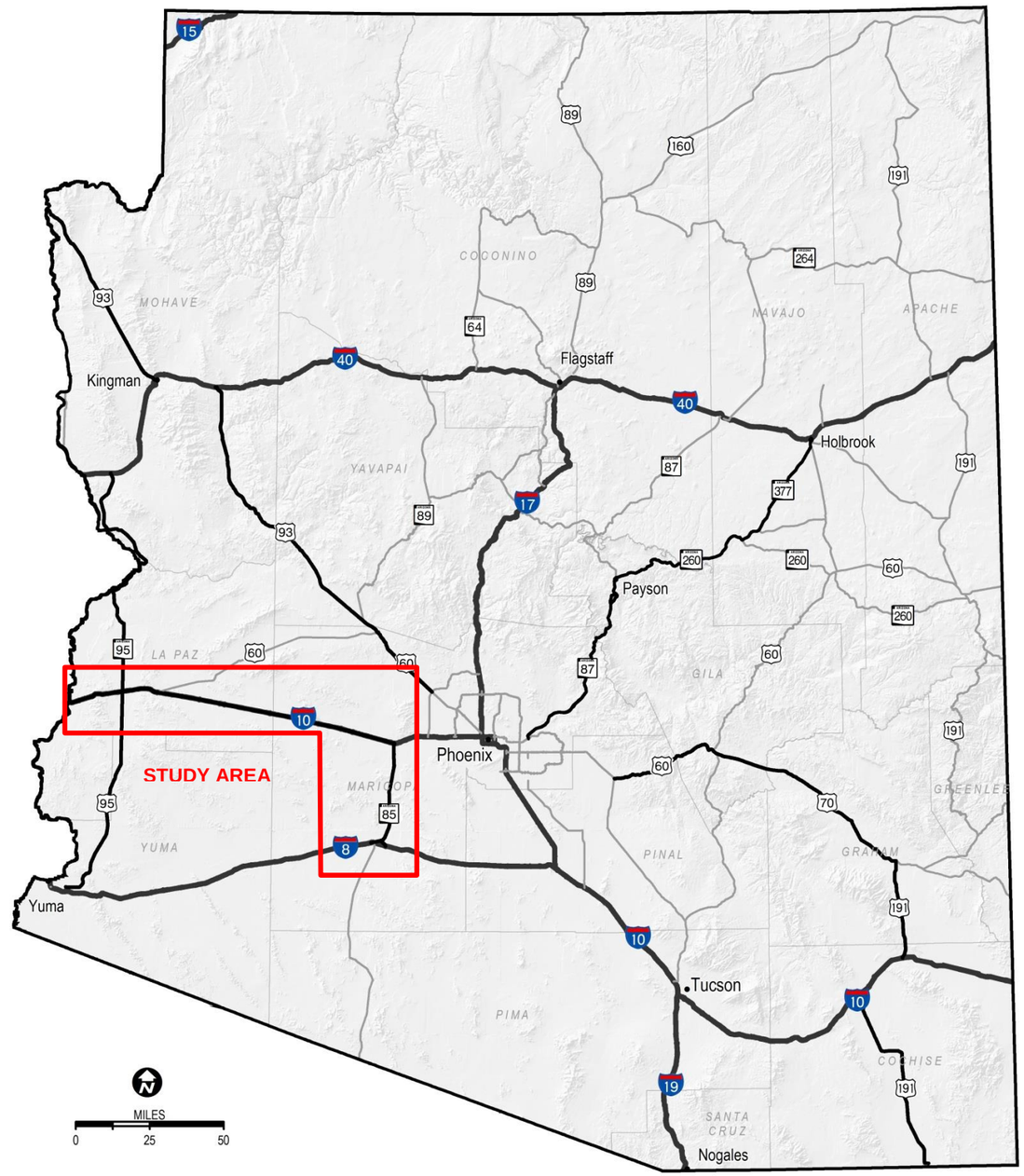
The third round (Round 3) of studies, initiated in fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 93/US 60: Nevada State Line to SR 303L

The studies under this program will assess the overall health, or performance, of the state's strategic highways. The Corridor Profile Studies will identify candidate projects for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

I-10/SR 85, California State Line to I-8, depicted in **Figure 1** and shown as the Study Area, is one of the strategic statewide corridors identified and is the subject of this Round 3 Corridor Profile Study.

Figure 1: Study Area: I-10/SR 85



1.1 Corridor Study Purpose

The purpose of the I-10/SR 85 Corridor Profile Study is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process established by the previous Round 1 and Round 2 corridor profile studies to:

- Inventory past improvement recommendations.
- Define corridor goals and objectives.
- Assess existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific projects that can provide quantifiable benefits relative to the performance measures.
- Prioritize projects for future implementation.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of prioritized potential solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-10/SR 85 Corridor Profile Study will define solutions and improvements for the corridor that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance. The following goals have been identified as the desired outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals.
- Develop solutions that address identified corridor needs based on measured performance.
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure.

1.3 Working Paper 4 Overview

The purpose of Working Paper 4 is to document the performance-based needs for the I-10/SR 85 Corridor within the study limits. Corridor needs are defined through a review of the difference in baseline corridor performance (Task 2) and the performance objectives (Task 3) for each of the five performance areas used to characterize the health of the I-10/SR 85 Corridor: pavement, bridge, mobility, safety, and freight. The product of Working Paper 4 is actionable performance needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

1.4 Corridor Overview

The I-10/SR 85 Corridor provides an important connection from Southern California to economic and recreational opportunities in Central Arizona and other destinations to the east. I-10 is a 4-lane divided freeway from the California border to SR 85, while SR 85 is generally a two-lane highway facility connecting I-10 to I-8. Together, the two roadways provide a passage from Southern California to Tucson while bypassing the Metropolitan Phoenix Area.

Plans have been made to upgrade SR 85 to a freeway facility between I-10 and I-8, which will greatly increase accessibility for both freight and tourism travel. I-10 between California and SR 85 is a direct connection between Phoenix and Los Angeles. Similarly, SR 85 between I-10 and I-8 is both a bypass route for freight traffic wishing to avoid the Phoenix Area and a major corridor in the linkage between Phoenix and San Diego. Therefore, the entire corridor is considered an important connection for both freight and tourism travel in the state.

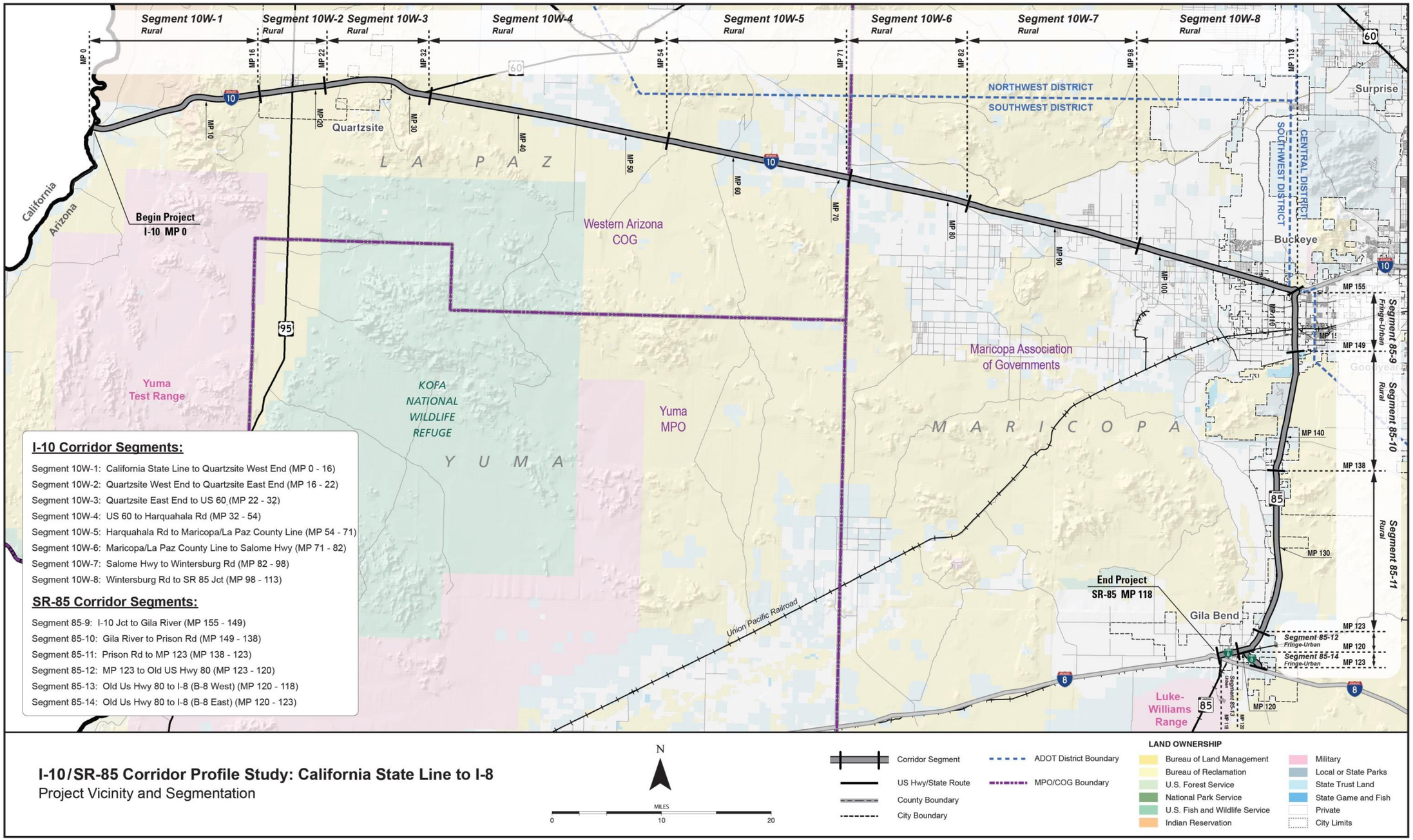
1.5 Study Location and Corridor Segments

The I-10/SR 85 Corridor extends from the California State Line (MP 0) to SR 85 (MP 113) and from I-10 (MP 155) to I-8 (MP 118) on SR 85, which is approximately 150 miles**.** This corridor provides a bypass to downtown Phoenix from the south and west and connects I-10 and I-8. Identification of highway segments was determined based on roadway, traffic and jurisdictional characteristics to allow for the appropriate level of analysis for similar operating environments between segments. Fourteen segments have been identified as described in Table 1 and illustrated in **Figure 2**. Based on team input and data collection, the segment limits may be adjusted as the study progresses. Initial segmentation was completed as shown in **Table 1** and also shown in **Figure 2**.

Table 1: I-10/SR 85 Corridor Segmentation

Segment	Route	Begin	End	Approximate Begin MP	Approximate End MP	Approximate Length (mi)	Through Lanes (NB, SB & EB, WB)	2014 Average Annual Daily Traffic Volume (VPD)	Character Description
10W-1	I-10	California State Line	West Quartzsite	0	16	16	2 EB, 2 WB	16,000 - 20,000	This segment includes the Ehrenberg Port of Entry at milepost 3.8 which is a required checkpoint for commercial traffic entering Arizona. It is a four-lane divided section that has been classified as a rural operating environment.
10W-2	I-10	West Quartzsite	East Quartzsite	16	22	6	2 EB, 2 WB	16,000 - 21,600	This segment passes through Quartzsite and includes the I-10/SR 95 junction. It is six miles long and sustains consistent traffic volumes on a four-lane section.
10W-3	I-10	East Quartzsite	Jct US 60	22	32	10	2 EB, 2 WB	18,500 - 21,600	This segment is 10 miles long between the eastern border of Quartzite and the I-10/US 60 junction. It has been classified as a rural environment and it is mostly flat with traffic volumes 16,000 to over 20,000 vehicles per day.
10W-4	I-10	Junction US 60	Harquehala Rd	32	54	22	2 EB, 2 WB	20,400 - 21,500	This segment is 22 miles long between the US 60 junction and Harquehala Road. It is a four-lane section that has been classified as a rural environment.
10W-5	I-10	Harquehala Rd	La Paz/ Maricopa County Border	54	71	17	2 EB, 2 WB	19,100 - 21,500	This segment runs from Eastern La Paz County to the Maricopa County border. It is 17 miles long and has been classified as a rural environment.
10W-6	I-10	La Paz/ Maricopa County Border	Salome Rd	71	82	11	2 EB, 2 WB	19,100 - 20,500	This segment is 11 miles long, includes two general purpose lanes in each direction, and has been classified as a rural environment.
10W-7	I-10	Salome Rd	Wintersburg Rd	82	98	16	2 EB, 2 WB	20,500 - 25,500	This segment includes the Town of Tonopah. It is a four-lane section where traffic volumes begin to increase towards the east.
10W-8	I-10	Wintersburg Rd	I-10/SR 85 Interchange	98	I-10 113, SR 85 155	15	2 EB, 2 WB	25,500 - 32,200	This segment is 15 miles long and includes the portion of I-10 that serves as a principal evacuation route for the Palo Verde Nuclear Generating Station, which is located six miles south of I-10. It is a four-lane section, it has been classified as a rural environment, and it has over 25,000 vehicles per day.
85-9	SR 95	I-10/SR 85 Interchange	Gila River (MP 149)	I-10 113, SR 85 155	149	6	2 EB, 2 WB	15,100 - 13,700	This segment is a four-lane section that connects I-10 south to the Gila River. It passes through the western portion on the Town of Buckeye and has been classified as a fringe urban operating environment.
85-10	SR 95	Gila River (MP 149)	Patterson Rd/ Prison Access	149	138	11	2 NB, 2 SB	15,100 - 8,900	This segment is 11 miles long and is a four-lane divided section. The southern limit provides direct access to the Arizona State Prison complex.
85-11	SR 95	Patterson Rd/ Prison Access	Gila Bend Limits	138	123	15	2 NB, 2 SB	8,900 - 10,600	This segment starts at the southern limits of Buckeye and ends at approximately the northern limits of Gila Bend. It is a four-lane divided section and has been classified as a rural environment.
85-12	SR 95	Gila Bend Limits	Jct B-8	123	120	3	2 NB, 2 SB	10,600 - 12,000	This segment transitions to one lane in each direction on a non-divided section. The speed limit drops entering into Gila Bend and this segment has been classified as fringe urban.
85-13	SR 95	Jct B-8	Jct I-8 WB	120	118	2	2 EB, 2 WB, 1 LT	9,300 – 11,500	This segment starts at SR 85 and transitions onto B-8 through Gila Bend. It is a five-lane arterial section with a dedicated left-turn lane. This segment provides direct access to commercial businesses within Gila Bend and acts as an arterial roadway.
85-14	SR 95	Jct B-8	Jct I-8 EB	SR 85 120	123	3	1 NB, 1 SB	12,000 – 12,100	This segment starts at SR 85 and transitions onto S Butterfield Trail. It is a two lane non-divided section that provides access to I-8 without going through Gila Bend. Various commercial businesses have direct access to this segment as well.

Figure 2: Segmentation Map: I-10/SR 85



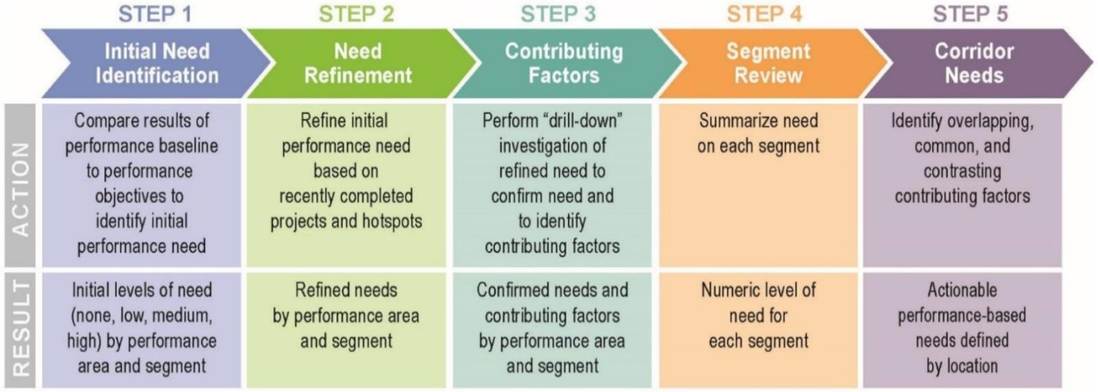
2.0 NEEDS ASSESSMENT PROCESS

A collaborative process involving ADOT Multimodal Planning Department (MPD) staff and the corridor profile study teams was used to develop a framework for the performance-based needs assessment process. The following guiding principles were developed as an initial step in process development:

- Corridor needs are defined as the difference between corridor performance and the performance objectives.
- The needs assessment process should be systematic, progressive, and repeatable, but also include engineering judgment.
- The process should consider all primary and secondary performance measures developed for the study.
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by milepost limits).
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

The performance-based needs assessment process is illustrated in **Figure 3** and described in the following sections of the working paper.

Figure 3: Needs Assessment Process



2.1 Step 1: Initial Need Identification

The first step in the needs assessment process links baseline (existing) corridor performance documented in Working Paper 2 with performance objectives documented in Working Paper 3. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of initial performance needs. This mathematical comparison results in an initial need rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process for the bridge performance measure is shown in **Figure 4**.

Figure 4: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need	Description
6.5	Good	None	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
	Fair		
	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
5.0	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)
	Poor		

Initial levels of needs for each performance measure are combined to produce a weighted initial need rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial need levels of None, Low, Medium, and High, respectively. A weight of 1.0 is applied to the Performance Index need and equal weights of 0.20 are applied to each need for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10. The secondary performance measure needs are added to the need from the Primary Index to create a cumulative measure of need. The resulting weighted initial level of need is assigned a level of None, Low, Medium, or High. With this approach, the resulting segment level of need is always equal to or higher than the Primary Index need.

2.2 Step 2: Need Refinement

In Step 2, the initial level of need for each segment is refined using the following information and engineering judgment.

- If an initial need is not identified, the existence of hot spots in the segment is justification for increasing the level of need from None to Low.
- Recently completed projects or projects under construction may be justification for lowering or eliminating a need.
- Programmed projects should not be used to lower the initial need because the project may not be implemented as planned. In addition, further investigations may suggest that changes in the scope of a programmed project may be warranted.

The resulting final need (potential increase, decrease, or no change from initial need) is carried forward for further evaluation in Step 3.

2.3 Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to identify contributing factors to the need. Typically, the same databases that are used to develop the baseline performance serve as the principal sources for the more detailed analysis. The databases used for diagnostic analysis are listed below.

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- Bridge Information and Storage System

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- Arizona Travel Demand Model (AZTDM)
- HERE Travel Time Database
- Highway Condition Reporting System (HCRS) Closure Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources are considered to help identify the contributing factors, such as:

- Maintenance history (from ADOT Maintenance Performance Control system (PeCos) for pavement), the level of past investments, or trends in historical data are used to help provide context for pavement and bridge history.
- Field observations from ADOT district personnel could be used to provide additional information regarding a need that has been identified
- Previous studies could be used to provide additional information regarding contributing factors to a need that has been identified

Step 3 results in the identification of contributing factors to needs by segment (and milepost locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance.

2.4 Step 4: Segment Review

In this step, the needs from Step 2 are quantified for each segment to numerically determine the level of need for each segment. Values of 0, 1, 2, and 3 are assigned to the final need levels (from Step 2) of None, Low, Medium, and High, respectively. A weight factor of 1.5 is applied to the performance areas that are identified as Emphasis Areas in Working Paper 3 and a weighted average need is calculated for each segment. The resulting average need value can be used to compare needs across corridors and to determine the location of the highest needs.

2.5 Step 5: Corridor Needs

In this step, the needs and contributing factors for each performance area are reviewed on a segment-by-segment basis to identify actionable needs and to facilitate the formation of solutions that address multiple performance areas and contributing factors. The intent of this process is to identify overlapping, common, and contrasting needs to help develop strategic solutions. This step results in the identification of corridor needs by specific location.

3.0 PAVEMENT PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10/SR 85 Corridor for the Pavement Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

3.1 Step 1: Initial Pavement Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10/SR 85 corridor were used to determine the initial pavement needs, as described in Section 2.1. The pavement condition data used to calculate baseline performance was provided by ADOT for the timeframe from 2014 through 2015.

Step 1 uses the scores for the Pavement Index primary performance measure and two secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures are Directional PSR and Percent Pavement Failure.

The performance scores, performance objectives, and initial levels of need for each pavement performance measure and for all pavement performance measures combined are shown in Table **2**.

The I-10/SR 85 Corridor initial pavement needs indicate that there is a low need in Segments 10-2, 10-4, 10-6, 10-8 and 85-10, 85-13 based primarily on a percentage of pavement failure on the segment.

3.2 Step 2: Final Pavement Needs

Once the initial pavement needs by segment for the I-10/ SR 85 Corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of pavement hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 3**.

Pavement Hot Spots

There are seven segments containing pavement failure hot spots. The locations of pavement hot spots are listed in **Table 3**. All hot spots are within segments that already have an identified initial need, so no adjustments were made to the need level of any segments to account for hot spots.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2016 that have the potential to mitigate a pavement need on a corridor segment.

There are five segments containing recently completed or under-construction projects which would supersede the pavement condition data, as shown in **Table 3**. This information was used to eliminate the need on three segments.

Planned or Programmed Projects

Information was noted in **Table 3** on pavement-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

3.3 Step 3: Pavement Contributing Factors

The final needs for the I-10/SR 85 Corridor were further investigated as described in Section 2.3. ADOT provided pavement rehabilitation project data for the last 20 years which was used to estimate the level of historical investment in each segment and is summarized in **Figure 5**.

In addition, PeCoS data was collected for each segment to estimate the level of pavement maintenance activity. If the PeCoS data showed a high level of maintenance investment, the overall historical investment was elevated by one need level (for example, from “Medium” to “High”). There are two segments with a high level of overall historical investment. Additional information regarding the determination of the level of historical investment is contained in **Appendix A**.

For the Pavement Performance Area, no additional data is readily available so the contributing factors simply identify the specific locations of needs, the level of historical investment, and any additional supporting information available from the ADOT Districts. A summary of this process is shown in **Table 4**.

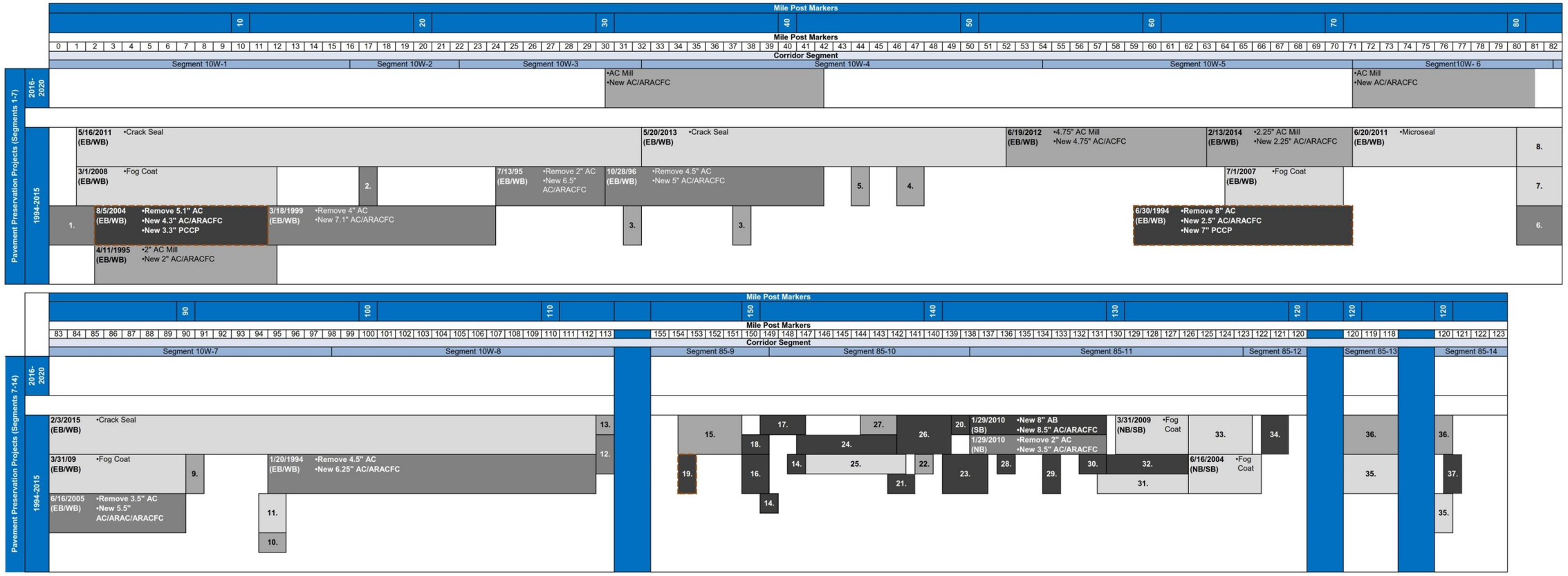
Table 2: Initial Pavement Needs (Step 1): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							EB/SB	NB/WB		EB/SB	NB/WB				
10-1	16	0-16	Interstate	3.76	Fair or Better	None	3.93	3.96	Fair or Better	None	None	13.0%	Fair or Better	Low	Low
10-2	6	16-22	Interstate	3.61	Fair or Better	None	4.06	3.87	Fair or Better	None	None	0.0%	Fair or Better	None	None
10-3	10	22-32	Interstate	3.90	Fair or Better	None	3.97	3.88	Fair or Better	None	None	0.0%	Fair or Better	None	None
10-4	22	32-54	Interstate	3.76	Fair or Better	None	3.74	3.52	Fair or Better	None	Low	27.0%	Fair or Better	High	Low
10-5	17	54-71	Interstate	4.37	Fair or Better	None	4.16	4.22	Fair or Better	None	None	0.0%	Fair or Better	None	None
10-6	11	71-82	Interstate	3.85	Fair or Better	None	3.68	3.55	Fair or Better	None	Low	18.0%	Fair or Better	Medium	Low
10-7	16	82-98	Interstate	3.95	Fair or Better	None	3.94	3.81	Fair or Better	None	None	0.0%	Fair or Better	None	None
10-8	15	98-113	Interstate	3.95	Fair or Better	None	3.80	3.67	Fair or Better	None	None	13.0%	Fair or Better	Low	Low
85-9	6	155-149	Highway	4.01	Fair or Better	None	3.63	3.85	Fair or Better	None	None	0.0%	Fair or Better	None	None
85-10	11	149-138	Highway	3.83	Fair or Better	None	4.11	3.82	Fair or Better	None	None	14.0%	Fair or Better	Low	Low
85-11	15	138-123	Highway	3.80	Fair or Better	None	3.78	4.35	Fair or Better	None	None	22.0%	Fair or Better	Medium	Low
85-12	3	123-120	Highway	3.32	Fair or Better	None	3.21	3.42	Fair or Better	Low	None	17.0%	Fair or Better	Medium	Low
85-13	2	120-118	Highway	5.00	Fair or Better	None	5.00	5.00	Fair or Better	None	None	0.00%	Fair or Better	None	None
85-14	3	120-123	Highway	5.00	Fair or Better	None	5.00	5.00	Fair or Better	None	None	0.00%	Fair or Better	None	None
Emphasis Area?	No	Weighted Average		3.89	Good	None									

Table 3: Final Pavement Needs (Step 2): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments		Final Need	Comments (may include programmed projects or issues from previous reports)
				Hot Spots	Previous Projects (which supersede condition data)		
10-1	16	0-16	Low	EB MP 12-13, WB MP 9-10, 11-12, and 15-16	None	Low	Failure hot spots EB MP 12-13, WB MP 9-10, 11-12, and 15-16
10-2	6	16-22	None	-	None	None	No need identified
10-3	10	22-32	None	-	None	None	No need identified
10-4	22	32-54	Low	EB MP 36-37, 38-45, and 47-48, WB MP 41-42, 47-48, and 51-52	Pavement Preservation (MP 42-52) completed 2/18/16	Low	Pavement preservation project addressed some hot spots but not all. Need level remains 'Low'. Project is programmed in FY 16 will address remaining hot spots
10-5	17	54-71	None	-	None	None	No need identified
10-6	11	71-82	Low	EB MP 77-79 and WB MP 71-73	None	Low	Failure hot spots EB MP 77-79 and WB MP 71-73; Project is programmed in FY 2019 (MP 71-81) should mitigate issues
10-7	16	82-98	None	-	None	None	No need identified; 395th Ave TI programmed FY 20 (MP 96.20)
10-8	15	98-113	Low	EB MP 107-109 and 112-113. WB MP 105-106	Pavement Rehab (MP 80-112.5) completed 2/3/15	None	Pavement rehab project addressed all issues. Need level reduced to 'None'; Desert Creek TI programmed FY 20 (MP 105.30)
85-9	6	155-149	None	-	None	None	No need identified
85-10	11	149-138	Low	NB MP 143-146	None	Low	Failure hot spots NB MP 143-146; Several intersection improvements recommended but not programmed
85-11	15	138-123	Low	SB MP 123-126 and 127-131	None	None	Pavement preservation (MP 121-131) is currently under construction and will mitigate issues. Need level reduced to 'None'
85-12	3	123-120	Low	SB MP 122-123	None	None	Pavement preservation (MP 121-131) is currently under construction and will mitigate issues. Need level reduced to 'None'
85-13	2	120-118	None	-	Pavement Preservation completed 5/5/14 for MP 117-120.25 (H800001C)	None	Limited Data Available
85-14	3	120-123	None	-	None	None	Limited Data Available

Figure 5: Pavement History: I-10/SR 85



Pavement Treatment Reference Numbers

1. **12/4/1999 (EB/WB):** 2" AC Mill, New 2.5" ARAC/ARACFC
2. **10/11/2000 (EB/WB):** New 2" AC
3. **6/10/2009 (EB/WB):** 2" AC Mill, New 2" AC/ACFC
4. **11/1/06 (EB/WB):** 4" AC Mill, New 4" AC/ARACFC
5. **10/15/2011 (EB/WB):** 3.5" AC Mill, New 3.5" AC/ACFC
6. **6/16/2005 (EB/WB):** 3.5" AC Mill, New 5.5" AC/ARAC/ARACFC
7. **3/31/09 (EB/WB):** Fog Coat
8. **2/3/2015 (EB/WB):** Crack Seal
9. **1/20/1994 (EB/WB):** 1.75" AC Mill, New 1.75" AC/ARACFC
10. **11/5/2008 (WB):** 2" AC Mill, New 2" AC/ACFC
11. **5/16/2011 (EB/WB):** Crack Seal
12. **6/21/1995 (EB/WB):** 3.75" AC Mill, New 6.75" AC
13. **10/27/2014 (EB):** 4" AC Mill, New 4" AC/ARACFC
14. **5/1/1995 (SB):** New 10" AB, New 8" AC/ARACFC
15. **6/18/1998 (NB/SB):** 3" AC Mill, New 2.5" AC/ARACFC
16. **6/18/1998 (NB/SB):** New 3.5" AC/ARACFC
17. **6/5/2000 (NB):** New 10" AB, New 8" AC/ACFC
18. **7/10/2003 (SB):** New 4" AB, New 8.5" AC/ARACFC
19. **9/23/2010 (NB/SB):** New 4" AB, New 13" PCCP, New 0.5" ARACFC
20. **5/31/1998 (SB):** New 7" AB, New 4" AC, Fog Coat
21. **6/15/1999 (NB):** New 4" AB, New 3.5" AC/ACFC
22. **11/13/2002 (NB):** 2.5" AC Mill, New 2.5" AC/ACFC
23. **3/17/2004 (NB/SB):** New 7" AB, New 7.5" AC/ARACFC
24. **12/15/2005 (NB):** New 5" AB, New 7.5" AC/ARACFC
25. **12/15/2005 (SB):** 1" AC Mill, New 0.5" ARACFC
26. **11/26/2008 (NB/SB):** New 8" AB, New 4" AC/ARACFC
27. **9/23/2010 (SB):** 3" AC Mill, New 3" AC/ACFC
28. **6/15/1999 (SB):** New 4" AB, New 3.5" AC/ACFC
29. **4/11/2000 (NB/SB):** New 4" AB, New 3.5" AC/ACFC
30. **4/11/2000 (NB):** New 4" AB, New 3.5" AC/ACFC
31. **8/9/2005 (NB):** 1" AC Mill, New 0.5" ARACFC
32. **8/9/2005 (SB):** New 9" AB, New 7.5" AC/ARACFC
33. **10/13/2005 (NB/SB):** 1" AC Mill, New 0.5" ARACFC
34. **4/11/2000 (NB/SB):** New 4" AB, New 4" AC/ACFC
35. **7/13/2009 (EB/WB):** Slurry Seal
36. **5/5/2014 (EB/WB):** 3" AC Mill, New 3" AC, Fog Coat
37. **8/29/2012 (EB/WB):** New 9" AB, New 7" AC/ARACFC

Legend

- New Paving or Reconstruction
- Mill and Overlay (Adding Structural Thickness)
- Mill and Replace (No Change Structural Thickness)
- Fog Coat or Thin Overlay Treatments
- PCCP Pavement Border
- AC Pavement Border

Table 4: Pavement Needs Contributing Factors (Step 3): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Bid History Investment	PeCoS History Investment	Resulting Historical Investment	Contributing Factors and Comments
10-1	16	0-16	Low	High	Low	High	Failure hot spots EB MP 12-13, WB MP 9-10, 11-12, and 15-16. Historical investment is high. No programmed projects identified.
10-2	6	16-22	None	Medium	Low	Medium	-
10-3	10	22-32	None	Medium	Medium	Medium	-
10-4	22	32-54	Low	Low	High	Medium	Failure hot spots EB MP 36-37, 38-45, and 47-48. WB MP 41-42, 47-48, and 51-52. 27% of segment has pavement failure. Historical investment level is low; Project is programmed for FY 16 (MP 30-42) should mitigate issues.
10-5	17	54-71	None	High	Low	High	No identified need, historical investment is high.
10-6	11	71-82	Low	Low	Low	Low	Failure hot spots: EB MP 77-79 and WB MP 71-73. Historical investment level is low. Project is programmed in FY 19 (MP 71-81) should mitigate issues.
10-7	16	82-98	None	Medium	Medium	Medium	395th Ave TI construction programmed FY 20.
10-8	15	98-113	None	Medium	Low	Medium	Failure hot spots EB MP 107-109 and 112-113. WB MP 105-106 has been addressed by recent pavement preservation project. Desert Creek TI construction programmed FY 20.
85-9	6	155-149	None	Low	Low	Low	-
85-10	11	149-138	Low	Low	Low	Low	Failure hot spots NB MP 143-146. Several intersection projects recommended but nothing programmed.
85-11	15	138-123	None	Low	High	Medium	Failure hot spots SB MP 123-126 and 127-131 have been addressed by recent pavement preservation project.
85-12	3	123-120	None	Low	Medium	Low	Failure hot spots SB MP 122-123 have been addressed by recent pavement preservation project.
85-13	2	120-118	None	Low	Low	Low	Limited data available for segment. Need level remains ‘None’ due to recently completed project.
85-14	3	120-123	None	Low	Low	Low	Limited data available for segment. Field review resulted in no identified need.

4.0 BRIDGE PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10/SR 85 Corridor for the Bridge Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

4.1 Step 1: Initial Bridge Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10/SR 85 Corridor were used to determine the initial bridge needs, as described in Section 2.1. The bridge condition data used to calculate baseline performance was provided by ADOT for the timeframe from 2012 to 2014.

Step 1 uses the scores for the Bridge Index primary performance measure and three secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The three secondary performance measures are Bridge Rating, Bridge Sufficiency, and Percent Functionally Obsolete Bridges.

The performance scores, performance objectives, and initial levels of need for each bridge performance measure and for all bridge performance measures combined are shown in **Table 5**.

For the Bridge Index, zero segments report a high level of need and three segments report a medium level of need. For all bridge performance measures combined, zero segments report a high level of initial need and three segments report a medium level of initial need.

4.2 Step 2: Final Bridge Needs

Once the initial bridge needs by segment for the I-10/SR 85 Corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of bridge hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 6**.

Bridge Hot Spots

A Bridge Hot Spot is determined by the individual category ratings (Deck, Superstructure, and Substructure). If a bridge has multiple ratings of 5 in two or more categories or a single rating of 4, it is considered a hot spot.

There are zero bridge hot spots within the I-10/SR 85 Corridor, so no adjustments were made to the need level of any segments to account for hot spots.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a bridge need on a corridor segment.

There are zero segments containing recently completed or under-construction projects.

Planned or Programmed Projects

Information was noted in **Table 6** on bridge-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

4.3 Step 3: Bridge Contributing Factors

The final needs for I-10/SR 85 Corridor were further investigated as described in Section 2.3. ADOT provided historical bridge rating data for the last 17 years which was used to investigate historical trends for each bridge and is summarized in **Figure 6**. A Bridge is deemed to have a potential historical issue if any category rating (Deck, Superstructure, Substructure, or Evaluation) increases or decreases more than two times in the last 17 years, or has a sufficiency drop of more than 20 points in that same time frame. These characteristics would indicate that investments are repeatedly being made or ignored on that structure.

There is one segment containing a bridge identified as having possible historical issues, Tom Wells Rd TI UP, located at MP 5.84 in Segment 10-1 has had its Superstructure Rating decrease 3 times since 1997. Segments 10-1, 10-2, and 10-3 contain bridges identified as being functionally obsolete. These characteristics are highlighted in **Table 6**. While historical issues and functional obsolescence were not used to adjust the level of need, they were listed in **Table 6** as input to the identification of contributing factors.

The current bridge ratings were reviewed to determine which rating (or ratings) were less than 6 (deck, superstructure, substructure, or structural evaluation rating). **Table 7** provides a summary of this information, identifies the bridges with potential historical issues, and provides any additional information related to the contributing factors.

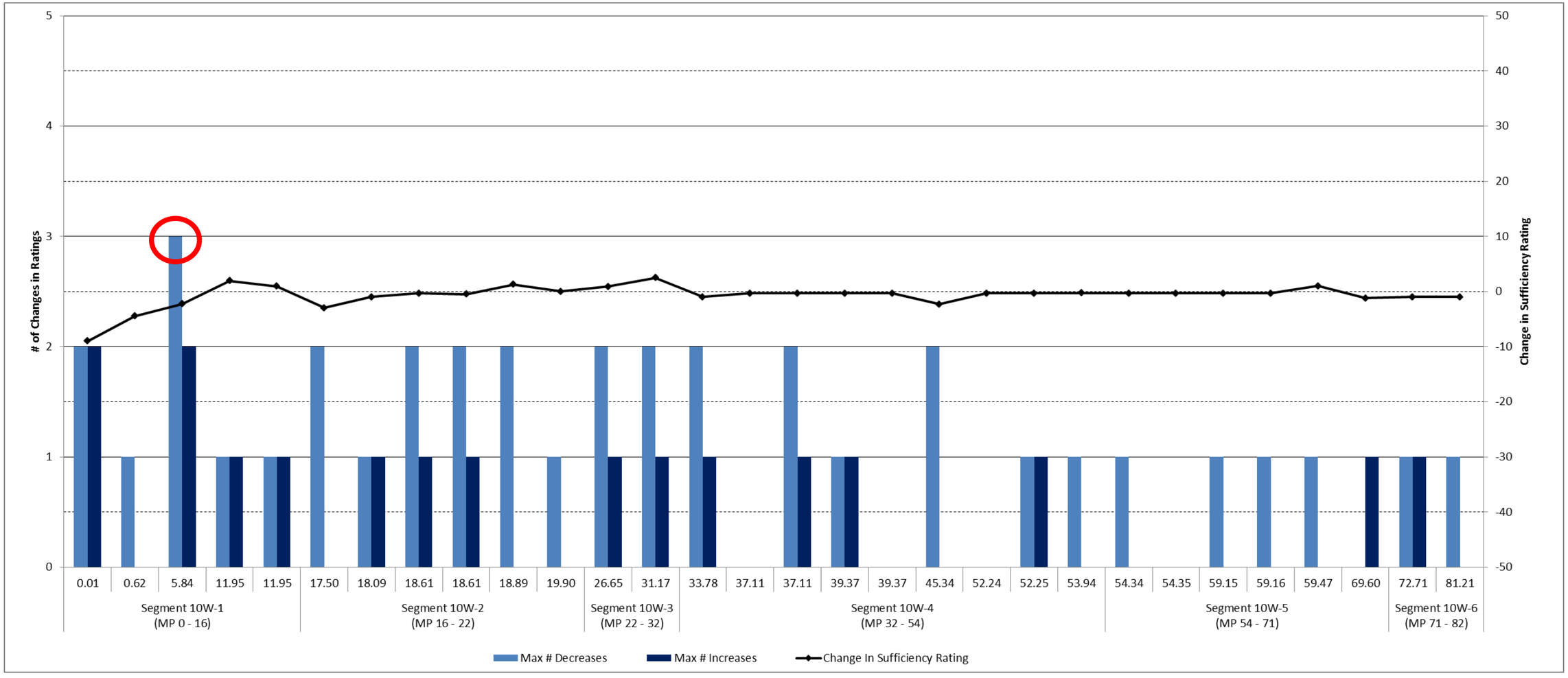
Table 5: Initial Bridge Needs (Step 1): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
10-1	16	0-16	5	5.11	Fair or Better	Medium	5	Fair or Better	Low	67.26	Fair or Better	Low	5.8%	Fair or Better	None	Medium
10-2	6	16-22	6	5.92	Fair or Better	Low	5	Fair or Better	Low	95.30	Fair or Better	None	9.0%	Fair or Better	None	Low
10-3	10	22-32	2	6.00	Fair or Better	None	6	Fair or Better	None	87.89	Fair or Better	None	36.8%	Fair or Better	Medium	Low
10-4	22	32-54	9	6.50	Fair or Better	None	5	Fair or Better	Low	97.22	Fair or Better	None	0.0%	Fair or Better	None	Low
10-5	17	54-71	6	6.48	Fair or Better	None	6	Fair or Better	None	98.35	Fair or Better	None	0.0%	Fair or Better	None	None
10-6	11	71-82	2	7.00	Fair or Better	None	7	Fair or Better	None	97.41	Fair or Better	None	0.0%	Fair or Better	None	None
10-7	16	82-98	6	6.25	Fair or Better	None	6	Fair or Better	None	97.70	Fair or Better	None	0.0%	Fair or Better	None	None
10-8	15	98-113	10	6.71	Fair or Better	None	5	Fair or Better	Low	96.12	Fair or Better	None	0.0%	Fair or Better	None	Low
85-9	6	155-149	0	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	None
85-10	11	149-138	6	6.53	Fair or Better	None	6	Fair or Better	None	99.47	Fair or Better	None	0.0%	Fair or Better	None	None
85-11	15	138-123	0	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	No Bridges	Fair or Better	None	None
85-12	3	123-120	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	83.40	Fair or Better	None	0.0%	Fair or Better	None	Medium
85-13	2	120-118	4	5.21	Fair or Better	Medium	5	Fair or Better	Low	89.61	Fair or Better	None	0.0%	Fair or Better	None	Medium
85-14	3	120-123	2	6.86	Fair or Better	None	6	Fair or Better	None	94.25	Fair or Better	None	0.0%	Fair or Better	None	None
Emphasis Area?	No	Weighted Average		5.40	Fair or Better	Medium										

Table 6: Final Bridge Needs (Step 2): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
10-1	16	0-16	5	Medium	None	-	Medium	Tom Wells Rd TI UP (#767) MP 5.84	1	Ehrenberg Bridge (Sub and Structural Evaluation), Poston Rd TI UP (Deck), Tom Wells Rd TI UP (Deck); No programmed projects
10-2	6	16-22	6	Low	None	-	Low	None	1	West Quartzsite TI UP (Deck), SR 95 UP (Deck); West Quartzsite TI Improvements programmed FY 16
10-3	10	22-32	2	Low	None	-	Low	None	1	No programmed projects
10-4	22	32-54	9	Low	None	-	Low	None	0	Vicksburg Rd TI UP (Deck); No programmed projects
10-5	17	54-71	6	None	None	-	None	None	0	
10-6	11	71-82	2	None	None	-	None	None	0	
10-7	16	82-98	6	None	None	-	None	None	0	
10-8	15	98-113	10	Low	None	-	Low	None	0	Oglesby Rd Ramp B UP (Deck)
85-9	6	155-149	0	None	None	-	None	None	0	No existing Bridges in segment; New Bridge Construction at Warner Street (MP 153) Programmed for FY 20
85-10	11	149-138	6	None	None	-	None	None	0	
85-11	15	138-123	0	None	None	-	None	None	0	No existing Bridges in segment
85-12	3	123-120	1	Medium	None	-	Medium	None	0	Gillespie Canal Br (Structural Evaluation); No programmed projects
85-13	2	120-118	4	Medium	None	-	Medium	None	0	Wash Bridge (Structural Evaluation), E Gila Bend TI UP (Deck), Sand Tank Wash Br (Structural Evaluation); No programmed projects
85-14	3	120-123	2	None	None	-	None	None	0	

Figure 6: Bridge History: I-10/SR 85 Segments 10W-1 – 10W-6



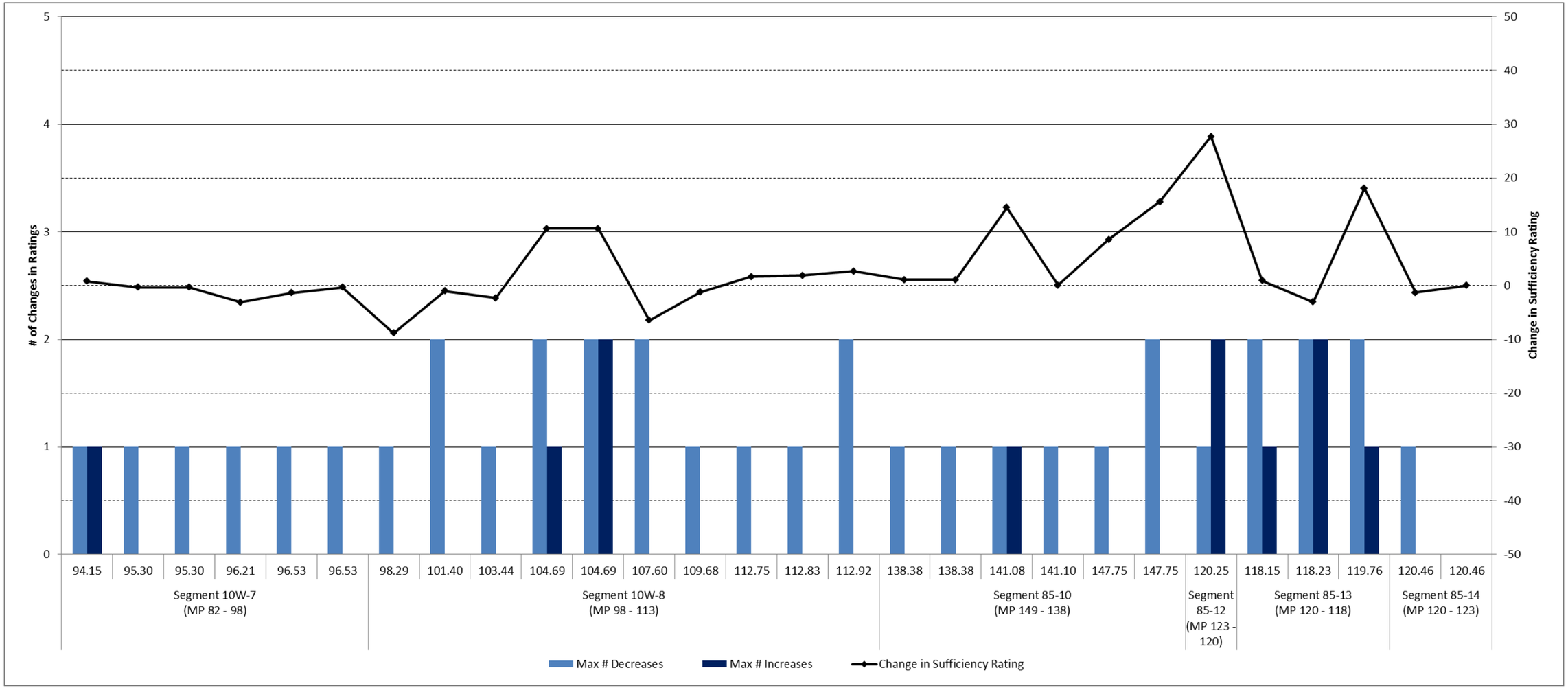
O Identifies the bridge indicated is of concern from a historical ratings perspective

Maximum # Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge.)

Maximum # Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment.)

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge.)

Figure 6: Bridge History: I-10/SR 85 Segments 10W-7 – 85-14



O Identifies the bridge indicated is of concern from a historical ratings perspective.

Maximum # Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge.)

Maximum # Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment.)

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge.)

Table 7: Bridge Needs Contributing Factors (Step 3): I-10/SR 85

Segment	Length (Miles)	Mileposts (MP)	# of Bridges	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
10-1	16	0-16	5	1	Medium	Ehrenberg Bridge (#619) MP .01	Current Sub Rating 5 Current Evaluation Rating of 5	Not identified in historical review	Not considered a hot spot due to Evaluation rating
						Poston Rd TI UP (#1704) MP 0.62	Current Deck Rating 5	Not identified in historical review	
						Tom Wells Rd TI UP (#767) MP 5.84	Current Deck Rating 5	May have historical issue	Superstructure rating decreased 3 times
10-2	6	16-22	6	1	Low	West Quartzsite TI UP (#826) MP 17.50	Current Deck rating 5	Not identified in historical review	
						SR 95 UP (#1451) MP 18.89	Current Deck Rating 5	Not identified in historical review	
10-3	10	22-32	2	1	Low	**No bridges with current ratings less than 6 or identified for historical review**			Percentage of functionally obsolete bridges in segment cause 'low' bridge need score
10-4	22	32-54	9	0	Low	Vicksburg Rd TI UP (#1207) MP 45.34	Current Deck Rating 5	Not identified in historical review	
10-5	17	54-71	6	0	None	**No bridges with current ratings less than 6 or identified for historical review**			
10-6	11	71-82	2	0	None	**No bridges with current ratings less than 6 or identified for historical review**			
10-7	16	82-98	6	0	None	**No bridges with current ratings less than 6 or identified for historical review**			
10-8	15	98-113	10	0	Low	Oglesby Rd Ramp B UP (#1725) MP 112.75	Current Deck Rating 5	Not identified in historical review	
85-9	6	155-149	0	0	None	**N/A**			
85-10	11	149-138	6	0	None	**No bridges with current ratings less than 6 or identified for historical review**			
85-11	15	138-123	0	0	None	**N/A**			
85-12	3	123-120	1	0	Medium	Gillespie Canal Br (#465) MP 120.25	Current Evaluation Rating 5	Not identified in historical review	Only bridge in segment 12. Structural evaluation rating of 5 causes 'medium' need score
85-13	2	120-118	4	0	Medium	Wash Bridge (#443) MP 118.15	Current Evaluation Rating 5	Not identified in historical review	
						E Gila Bend TI UP (#1345) MP 119.42	Current Deck Rating 5	Not identified in historical review	
						Sand Tank Wash Br (#444) MP 119.76	Current Evaluation Rating 5	Not identified in historical review	
85-14	3	120-123	2	0	None	**No bridges with current ratings less than 6 or identified for historical review**			

5.0 MOBILITY PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for I-10/SR 85 Corridor for the Mobility Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

5.1 Step 1: Initial Mobility Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10/SR 85 Corridor were used to determine the initial mobility needs, as described in Section 2.1. The mobility condition data used to calculate baseline performance was provided by ADOT for 2014 for the existing traffic volumes and travel time data, 2014 for bicycle accommodation data, 2035 for future traffic volumes, and 2010-2014 for the closure data.

Step 1 uses the scores for the Mobility Index primary performance measure and six secondary performance measures to determine the level of need for each performance measure by segment. The six secondary performance measures are Future Daily Volume-to-Capacity (V/C), Existing Directional Peak Hour V/C, Directional Closure Extent, Directional Travel Time Index (TTI), Directional Planning Time Index (PTI), and Bicycle Accommodation.

The performance scores, performance objectives, and initial levels of need for each mobility performance measure and for all mobility performance measures combined are shown in **Table 8**.

For the Mobility Index and Future Daily V/C, Segments 85-12 and 85-14 report a high level of need, and Segment 10-8 reports a medium level of need for Future Daily V/C. For Directional Closure Extent, Segment 85-9 reports a high level of need. Segment 85-13 Northbound and Segment 85-14 Southbound report a medium level of need. For Directional PTI, Segments 10-1 Westbound, Northbound Segments 85-10, 85-13, and 85-14, and Southbound Segments 85-9 and 85-11 report a high level of need. Eastbound Segment 10-1 reports a medium level of need in For Bicycle Accommodation, Segments 85-12, 85-13, and 85-14 report a high level of need. For all mobility performance measures combined, two of the 14 segments, Segments 85-12 and 85-14 report a high level of initial need.

5.2 Step 2: Final Mobility Needs

Once the initial mobility needs by segment for the I-10/SR 85 Corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 9**.

Recently Completed and Under-Construction Mobility Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a mobility need on a corridor segment.

There are no segments containing recently completed projects which would supersede the mobility condition data, as shown in **Table 9**.

Planned or Programmed Projects

Information was noted in **Table 9** on mobility-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

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Table 8: Initial Mobility Needs (Step 1): I-10/SR 85

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											NB/WB	EB/SB		NB/WB	EB/SB	NB/WB	EB/SB		NB/SB	EB/SB
10-1	0-16	16	Rural	Uninterrupted	0.27	Fair or Better	None	0.30	Fair or Better	None	0.28	0.28	Fair or Better	None	None	0.30	0.05	Fair or Better	None	None
10-2	16-22	6	Rural	Uninterrupted	0.30	Fair or Better	None	0.32	Fair or Better	None	0.29	0.29	Fair or Better	None	None	0.23	0.03	Fair or Better	None	None
10-3	22-32	10	Rural	Uninterrupted	0.27	Fair or Better	None	0.29	Fair or Better	None	0.28	0.28	Fair or Better	None	None	0.08	0.18	Fair or Better	None	None
10-4	32-54	22	Rural	Uninterrupted	0.31	Fair or Better	None	0.34	Fair or Better	None	0.34	0.34	Fair or Better	None	None	0.14	0.11	Fair or Better	None	None
10-5	54-71	17	Rural	Uninterrupted	0.29	Fair or Better	None	0.32	Fair or Better	None	0.29	0.29	Fair or Better	None	None	0.13	0.28	Fair or Better	None	None
10-6	71-82	11	Rural	Uninterrupted	0.29	Fair or Better	None	0.32	Fair or Better	None	0.31	0.27	Fair or Better	None	None	0.24	0.36	Fair or Better	None	Low
10-7	82-98	16	Rural	Uninterrupted	0.32	Fair or Better	None	0.36	Fair or Better	None	0.34	0.29	Fair or Better	None	None	0.40	0.11	Fair or Better	Low	None
10-8	98-113	15	Rural	Uninterrupted	0.53	Fair or Better	None	0.70	Fair or Better	Medium	0.35	0.34	Fair or Better	None	None	0.12	0.11	Fair or Better	None	None
85-9	155-149	6	Urban	Uninterrupted	0.30	Fair or Better	None	0.39	Fair or Better	None	0.18	0.18	Fair or Better	None	None	0.07	0.77	Fair or Better	None	High
85-10	149-138	11	Rural	Uninterrupted	0.23	Fair or Better	None	0.28	Fair or Better	None	0.16	0.15	Fair or Better	None	None	0.25	0.00	Fair or Better	None	None
85-11	138-123	15	Rural	Uninterrupted	0.17	Fair or Better	None	0.20	Fair or Better	None	0.09	0.09	Fair or Better	None	None	0.13	0.03	Fair or Better	None	None
85-12	123-120	3	Rural	Interrupted	0.92	Fair or Better	High	1.11	Fair or Better	High	0.56	0.56	Fair or Better	None	None	0.27	0.07	Fair or Better	None	None
85-13	120-118	2	Urban	Interrupted	0.32	Fair or Better	None	0.35	Fair or Better	None	0.25	0.25	Fair or Better	None	None	*No Data*	*No Data*	Fair or Better	N/A	N/A
85-14	120-123	3	Urban	Interrupted	1.01	Fair or Better	High	1.24	Fair or Better	High	0.67	0.66	Fair or Better	None	None	*No Data*	*No Data*	Fair or Better	N/A	N/A
Mobility Emphasis Area		Yes	Weighted Average		0.33	Good	None													

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional TTI (all vehicles)					Directional PTI (all vehicles)					Bicycle Accommodation			Initial Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					NB/WB	EB/SB		NB/WB	EB/SB	WB/NB	EB/SB		WB/NB	EB/SB				
10-1	0-16	16	Rural	Uninterrupted	1.20	1.17	Fair or Better	None	None	1.57	1.54	Fair or Better	High	Medium	100%	Fair or Better	None	Low
10-2	16-22	6	Rural	Uninterrupted	1.13	1.10	Fair or Better	None	None	1.30	1.25	Fair or Better	None	None	100%	Fair or Better	None	None
10-3	22-32	10	Rural	Uninterrupted	1.15	1.10	Fair or Better	None	None	1.34	1.24	Fair or Better	None	None	99%	Fair or Better	None	None
10-4	32-54	22	Rural	Uninterrupted	1.11	1.09	Fair or Better	None	None	1.24	1.23	Fair or Better	None	None	100%	Fair or Better	None	None
10-5	54-71	17	Rural	Uninterrupted	1.11	1.08	Fair or Better	None	None	1.27	1.20	Fair or Better	None	None	100%	Fair or Better	None	None
10-6	71-82	11	Rural	Uninterrupted	1.10	1.09	Fair or Better	None	None	1.21	1.23	Fair or Better	None	None	100%	Fair or Better	None	Low
10-7	82-98	16	Rural	Uninterrupted	1.10	1.10	Fair or Better	None	None	1.24	1.23	Fair or Better	None	None	100%	Fair or Better	None	Low
10-8	98-113	15	Rural	Uninterrupted	1.11	1.10	Fair or Better	None	None	1.25	1.25	Fair or Better	None	None	100%	Fair or Better	None	Low
85-9	155-149	6	Urban	Uninterrupted	1.00	1.05	Fair or Better	None	None	1.32	1.76	Fair or Better	None	High	88%	Fair or Better	None	Low
85-10	149-138	11	Rural	Uninterrupted	1.07	1.00	Fair or Better	None	None	1.83	1.07	Fair or Better	High	None	100%	Fair or Better	None	Low
85-11	138-123	15	Rural	Uninterrupted	1.01	1.09	Fair or Better	None	None	1.16	1.84	Fair or Better	None	High	94%	Fair or Better	None	Low
85-12	123-120	3	Rural	Interrupted	1.00	1.19	Fair or Better	None	None	1.00	3.19	Fair or Better	None	None	32%	Fair or Better	High	High
85-13	120-118	2	Urban	Interrupted	1.85	1.47	Fair or Better	Medium	None	72.41	4.26	Fair or Better	High	Low	47%	Fair or Better	High	Low
85-14	120-123	3	Urban	Interrupted	1.28	1.89	Fair or Better	None	Medium	9.05	4.25	Fair or Better	High	Low	42%	Fair or Better	High	High

Table 9: Final Mobility Needs (Step 2): I-10/SR 85

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2014	Final Need	Planned and Programmed Future Projects
10-1	0-16	16	Low	Ehrenberg POE Improvements under construction	Low	Planned: - Widen the mainline to six lanes - I-10 Multimodal Corridor Profile Study - Poston Rd TI (MP 1) - La Paz Transportation Study - Ehrenberg Rest Area Improvements (MP 4) - AZ Statewide Rest Areas Study - Tom Wells Rd TI (MP 5), Dome Rock Rd TI (MP 11) - I-10 Multimodal Corridor Profile Study
10-2	16-22	6	None	None	None	Programmed: - West Quartzsite TI Improvements FY 16 Planned: -Widen the mainline to six lanes - I-10 Multimodal Corridor Profile Study - Riggles Avenue TI (MP 19) - I-10 Multimodal Corridor Profile Study
10-3	22-32	10	None	None	None	Planned: - Widen the mainline to six lanes - I-10 Multimodal Corridor Profile Study - Gold Nugget Rd TI (MP 26), US 60 T (MP 31) - I-10 Multimodal Corridor Profile Study
10-4	32-54	22	None	Bouse Wash Rest Area Rehab at MP 52.0	None	Planned: - Widen the mainline to six lanes I-10 Multimodal Corridor Profile Study - Harquahala/Hovatter Rd TI (MP 53) - La Paz County Comprehensive Plan
10-5	54-71	17	None	None	None	Planned: - Widen the mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-6	71-82	11	Low	None	Low	Planned: - Widen the mainline to six lanes - I-10 Multimodal Corridor Profile Study - Salome Rd TI (MP 81) - I-10 Multimodal Corridor Profile Study
10-7	82-98	16	Low	Burnt Wells Rest Area Rehab at MP 86.0	Low	Programmed: - 395th Ave TI (MP 96) - RTP FY 20 Planned: - Widen the mainline to eight lanes plus HOV - Key Commerce Corridors - 459th Ave TI (MP 88), 443rd Ave TI (MP 90), 427th Ave TI (MP 92) - BQAZ - 379th Ave Signalized TI (MP 98) - BQAZ
10-8	98-113	15	Low	None	Low	Programmed: - Desert Creek Parkway TI (MP 105) - RTP FY 20 Planned: - Widen the mainline to eight lanes plus HOV - Key Commerce Corridors - System Interchange I-10 to Hassayampa Freeway (MP 100), I-10/SR 85 System TI (MP 112) - BQAZ - 347th Ave TI (MP 102), Johnson Rd TI (MP 107), Wilson Rd TI (MP 110) - BQAZ

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2014	Final Need	Planned and Programmed Future Projects
85-9	155-149	6	Low	None	Low	Programmed: - Warner Street Bridge (MP 153) - RTP FY 20 Planned: - Widen SR 85 to six lane freeway - MAG 2035 RTP - TI improvements at Lower Buckeye Rd (MP 154), Broadway Rd (MP 153), Southern Ave (MP 152), Baseline Rd (MP 151), MC-85 (MP 150.5), Hazen Rd (MP 149) - SR 85 Access Management Study - NB/SB DMS (MP 152/153) - AZ Statewide DMS Plan
85-10	149-138	11	Low	None	Low	Planned: - Widen SR 85 to six lane freeway - MAG 2035 RTP - TI improvements at Robbins Butte (MP 147), Riggs Rd (MP 140) - SR 85 Access Management Study - Buckeye Hills TI (MP 144), Patterson Rd TI (MP 138) - BQAZ - Hassayampa Freeway Interchange (MP 141) - BQAZ
85-11	138-123	15	Low	None	Low	Planned: - Widen SR 85 to six lane freeway - MAG 2035 RTP - TI Improvements at MP 136, Woods Rd (MP 134), MP 133, Pierpont Rd (MP 131), Gila Mountain Rd(MP 128) - BQAZ - Watermelon Rd At-Grade Crossing (MP 123) - SR 85 Access Management Study
85-12	123-120	3	High	None	High	Planned: - Widen SR 85 to six lane freeway - MAG 2035 RTP - Construct 4 lane freeway facility to I-8 interchange - DCR - De Anza Scenic Way TI (MP 122) - BQAZ - Gila Bend Access Rd At-Grade Crossing (MP 121.68) - DCR - Maricopa Rd At-Grade Crossing (MP 120.68) - SR 85 Access Management Study - SB DMS (MP 120) - AZ Statewide DMS Plan
85-13	120-118	2	Low	None	Low	Planned: - Construct 4 lane freeway facility to I-8 interchange - DCR
85-14	120-123	3	High	None	High	Planned: - Construct 4 lane freeway facility to I-8 interchange - DCR - I-8 System Interchange - MAG 2035 RTP

5.3 Step 3: Mobility Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future level of service (LOS), percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks, and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter "grade" between "A" and "F" for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of "A", "B", and "C" are generally considered highly acceptable. A LOS value of "D" is generally considered moderately acceptable. LOS values of "E" and "F" are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points, and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper 2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Mobility-Related Infrastructure

Mobility-related infrastructure refers to devices or features at specific locations that influence mobility performance. Examples include dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of mobility-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor mobility performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Mobility Needs Contributing Factors

Table 10 summarizes the potential contributing factors to mobility needs on the I-10/SR 85 Corridor.

Table 10: Mobility Needs Contributing Factors (Step 3): I-10/SR 85

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)	SB Buffer Index (PTI-TTI)	
10-1	0-16	16	Low	Interstate	Rural	Level	2	72.2	No	Divided	0%	A/B	A/B	26%	0.37	0.37	Ehrenberg Port of Entry; DMS EB MP 15.6
10-2	16-22	6	None	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.17	0.15	None
10-3	22-32	10	None	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.19	0.14	None
10-4	32-54	22	None	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	25%	0.13	0.14	DMS EB MP 49.4
10-5	54-71	17	None	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.16	0.12	None
10-6	71-82	11	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.11	0.14	None
10-7	82-98	16	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.14	0.13	None
10-8	98-113	15	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A/B	A/B	26%	0.14	0.15	DMS EB MP 110.3
85-9	155-149	6	Low	State Highway	Fringe Urban	Level	2	52.7	No	Divided	0%	A-C	A-C	19%	0.32	0.71	Railroad Crossing at MP 151
85-10	149-138	11	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A/B	A/B	21%	0.76	0.07	None
85-11	138-123	15	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A/B	A/B	26%	0.15	0.75	None
85-12	123-120	3	High	State Highway	Rural	Level	1	43.2	No	Non-Divided	50%	A/B	A/B	22%	0.00	2.00	None
85-13	120-118	2	Low	State Highway	Fringe Urban	Level	2	35	No	Non-Divided	0%	A-C	A-C	7%	70.56	2.79	Arterial roadway for Gila Bend
85-14	120-123	3	High	State Highway	Fringe Urban	Level	1	49.5	No	Non-Divided	10%	A-C	A-C	15%	7.77	2.36	None

Table 10: Mobility Needs Contributing Factors (Step 3 Continued): I-10/SR 85

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Planned and Programmed Future Projects	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
10-1	0-16	16	Low	14	14	100%	0	0%	0	0%	Ehrenberg POE at AZ/CA Border	Planned: - Widen the mainline to six lanes - Poston Rd TI (MP 1) - Ehrenberg Rest Area Improvements (MP 4) - Tom Wells Rd TI (MP 5), Dome Rock Rd TI (MP 11)	- Ehrenberg POE at AZ/CA border resulting in high PTI values - 100% of closures due to incidents
10-2	16-22	6	None	6	6	100%	0	0%	0	0%	None	Programmed: - West Quartzsite TI Improvements FY 16 Planned: - Widen the mainline to six lanes - Riggles Avenue TI (MP 19)	- No identified need
10-3	22-32	10	None	13	13	100%	0	0%	0	0%	None	Planned: - Widen the mainline to six lanes - Gold Nugget Rd TI (MP 26), US 60 T (MP 31	- No identified need - 100% of closures due to incidents
10-4	32-54	22	None	25	25	100%	0	0%	0	0%	None	Planned: - Widen the mainline to six lanes - Harquahala/Hovatter Rd TI (MP 53)	- No identified need - 100% of closures due to incidents
10-5	54-71	17	None	19	19	100%	0	0%	0	0%	None	Planned: - Widen the mainline to six lanes	- No identified need - 100% of closures due to incidents
10-6	71-82	11	Low	16	16	100%	0	0%	0	0%	None	Planned: - Widen the mainline to six lanes - Salome Rd TI (MP 81)	- Low level of closure frequency in EB direction - 100% of closures due to incidents
10-7	82-98	16	Low	25	25	100%	0	0%	0	0%	None	Programmed: - 395th Ave TI (MP 96) - RTP FY 20 Planned: - Widen the mainline to eight lanes plus HOV - 459th Ave TI (MP 88), 443rd Ave TI (MP 90), 427th Ave TI (MP 92) - 379th Ave Signalized TI (MP 98)	- Low level of closure frequency in WB direction - 100% of closures due to incidents
10-8	98-113	15	Low	17	17	100%	0	0%	0	0%	None	Programmed: - Desert Creek Parkway TI (MP 105) - RTP FY 20 Planned: - Widen the mainline to eight lanes plus HOV - System Interchange I-10 to Hassayampa Freeway (MP 100), I-10/SR 85 System TI (MP 112) - 347th Ave TI (MP 102), Johnson Rd TI (MP 107), Wilson Rd TI (MP 110)	- Elevated future daily V/C - 100% of closures due to incidents

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Planned and Programmed Future Projects	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
85-9	155-149	6	Low	24	24	100%	0	0%	0	0%	None	Programmed: - Warner Street Bridge (MP 153) - RTP FY 20 Planned: - Widen SR 85 to six lane freeway - TI improvements at Lower Buckeye Rd (MP 154), Broadway Rd (MP 153), Southern Ave (MP 152), Baseline Rd (MP 151), MC-85 (MP 150.5), Hazen Rd (MP 149) - NB/SB DMS (MP 152/153)	- SB closure frequency elevated, 100% due to incidents - Elevated PTI in SB direction causing increased SB buffer index score - At-grade railroad crossing at MP 151
85-10	149-138	11	Low	4	4	100%	0	0%	0	0%	None	Planned: - Widened SR 85 to six lane freeway - TI improvements at Robbins Butte (MP 147), Riggs Rd (MP 140) - Buckeye Hills TI (MP 144), Patterson Rd TI (MP 138) - Hassayampa Freeway Interchange (MP 141)	- Elevated NB PTI causing increased NB buffer index score
85-11	138-123	15	Low	3	3	100%	0	0%	0	0%	None	Planned: - Widen SR 85 to six lane freeway - TI Improvements at MP 136, Woods Rd (MP 134), MP 133, Pierpont Rd (MP 131), Gila Mountain Rd (MP 128) - Watermelon Rd At-Grade Crossing (MP 123)	- Elevated SB PTI causing increased SB buffer index score
85-12	123-120	3	High	4	4	100%	0	0%	0	0%	None	Planned: - Widen SR 85 to six lane freeway - Construct 4 lane freeway facility to I-8 interchange - De Anza Scenic Way TI (MP 122) - Gila Bend Access Rd At-Grade Crossing (MP 121.68) - Maricopa Rd At-Grade Crossing (MP 120.68) - SB DMS (MP 120)	- Elevated mobility index score due to current and future V/C - Bicycle Accommodation showing high level of need due to shoulder widths
85-13	120-118	2	Low	0	0	0%	0	0%	0	0%	None	Planned: - Construct 4 lane freeway facility to I-8 interchange	- Elevated NB TTI and PTI scores, possibly due to construction staging - Arterial roadway for Main St in Gila Bend - Many at-grade access points throughout segment
85-14	120-123	3	High	0	0	0%	0	0%	0	0%	None	Planned - Construct 4 lane freeway facility to I-8 interchange - I-8 System Interchange	- Elevated mobility index scores due to current and future V/C - Elevated TTI and PTI scores, possibly due to construction staging - Bicycle Accommodation showing high level of need due to shoulder widths

6.0 SAFETY PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10/SR 85 Corridor for the Safety Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

6.1 Step 1: Initial Safety Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10/SR 85 Corridor were used to determine the initial safety needs, as described in Section 2.1. The safety data used to calculate baseline performance was provided by ADOT for the timeframe from 2010 through 2014.

Step 1 uses the scores for the Safety Index primary performance measure and two of the five secondary safety performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures used are the Directional Safety Index and the Strategic Highway Safety Plan (SHSP) Top 5 Emphasis Area Behaviors. The three other secondary safety performance measures (Truck-Involved Crashes, Motorcycle-Involved Crashes, and Non-Motorized Crashes) exhibited small crash sample sizes in their entirety and were not considered in the Safety Performance Area needs assessment (refer to sample size criteria documented in Working Paper 2). Corridor segments that exhibited small crash sample sizes for the SHSP Top 5 Emphasis Area Behaviors were also excluded from the safety needs assessment.

The performance scores, performance objectives, and initial levels of need for each safety performance measure and for all safety performance measures combined are shown in **Table 11**.

For the Safety Index, Segments 10-4, 10-5, 10-6, 10-7, and 85-9 report a high level of need. For the secondary Directional Safety Index, Segments 10-2, 10-4, 10-7, and 10-9 report a high level of need northbound and Segments 10-4, 10-5, 10-6, 10-7, and 85-9 report a high level of need southbound, with Northbound Segments 10-1 and 10-5 report medium level of need and Southbound Segments 10-3, 10-8, and 85-10 report medium level of need. For the SHSP Top 5 Emphasis Area Behaviors, Segments 10-1 and 10-6 report high levels of need. For Truck-Involved Crashes, Segments 10-5, 10-7, and 10-5 report a high level of need, and Segment 10-6 reports a medium level of need. As mentioned, Motorcycle-Involved Crashes and Non-Motorized Crashes were not considered in the needs assessment due to small crash sample sizes. For all safety performance measures combined, five segments, Segments 10-4, 10-5, 10-6, 10-7, and 85-9, report a high level of initial need; and Segment 10-3 reports a medium level of initial need.

6.2 Step 2: Final Safety Needs

Once the initial safety needs by segment for the I-10/SR 85 Corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of crash hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 12**.

Safety Hot Spots

A Safety Hot Spot is determined by analyzing the densest locations of fatal and incapacitating injury crashes within the Corridor. Locations that are determined and have a statistically higher density of fatal and incapacitating injury crashes are considered Hot Spots.

There are seven segments containing a safety hot spot. The location of the safety hot spots are listed in **Table 12**. All safety hot spots found within the corridor are located within a segment that already has an identified initial need, so no adjustments were made to the need level of the segment to account for the hot spot.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant, recently completed, and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a safety need on a corridor segment.

Six segments were identified as having relevant recently completed or under construction projects. These projects, however, did not address all of the needs for the segments therefore the level of need was not changed.

Planned or Programmed Projects

Information was noted in **Table 12** on safety-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 11: Initial Safety Needs (Step 1): I-10/SR 85

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				Performance Score	Performance Objective	Level of Need	NB/WB Directional Safety Index	EB/SB Directional Safety Index	Performance Objective	NB/WB Level of Need	EB/SB Level of Need	Performance Score	Performance Objective	Level of Need
10-1	Rural 4 Lane Freeway with Daily Volume < 25,000	16	0-16	0.76	Average or Better	None	1.10	0.43	Average or Better	Medium	None	58%	Average or Better	High
10-2	Rural 4 Lane Freeway with Daily Volume < 25,000	6	16-22	0.99	Average or Better	Low	1.86	0.12	Average or Better	High	None	40%	Average or Better	None
10-3	Rural 4 Lane Freeway with Daily Volume < 25,000	10	22-32	1.03	Average or Better	Low	0.87	1.20	Average or Better	None	Medium	54%	Average or Better	Medium
10-4	Rural 4 Lane Freeway with Daily Volume < 25,000	22	32-54	1.79	Average or Better	High	1.65	1.92	Average or Better	High	High	54%	Average or Better	Medium
10-5	Rural 4 Lane Freeway with Daily Volume < 25,000	17	54-71	1.60	Average or Better	High	1.12	2.08	Average or Better	Medium	High	35%	Average or Better	None
10-6	Rural 4 Lane Freeway with Daily Volume < 25,000	11	71-82	1.66	Average or Better	High	0.70	2.62	Average or Better	None	High	56%	Average or Better	High
10-7	Rural 4 Lane Freeway with Daily Volume < 25,000	16	82-98	2.60	Average or Better	High	3.72	1.48	Average or Better	High	High	40%	Average or Better	None
10-8	Rural 4 Lane Freeway with Daily Volume > 25,000	15	98-113	1.05	Average or Better	Low	0.71	1.39	Average or Better	None	Medium	50%	Average or Better	Low
85-9	2 or 3 or 4 Lane Divided Highway	6	155-149	3.12	Average or Better	High	3.20	3.05	Average or Better	High	High	Insufficient Data	Average or Better	N/A
85-10	2 or 3 or 4 Lane Divided Highway	11	149-138	0.54	Average or Better	None	0.00	1.08	Average or Better	None	Medium	Insufficient Data	Average or Better	N/A
85-11	2 or 3 or 4 Lane Divided Highway	15	138-123	0.26	Average or Better	None	0.03	0.50	Average or Better	None	None	Insufficient Data	Average or Better	N/A
85-12	2 or 3 Lane Undivided Highway	3	123-120	Insufficient Data	Average or Better	N/A	Insufficient Data	Insufficient Data	Average or Better	N/A	N/A	Insufficient Data	Average or Better	N/A
85-13	4 or 5 Lane Undivided Highway	2	120-118	Insufficient Data	Average or Better	N/A	Insufficient Data	Insufficient Data	Average or Better	N/A	N/A	Insufficient Data	Average or Better	N/A
85-14	2 or 3 Lane Undivided Highway	3	120-123	Insufficient Data	Average or Better	N/A	Insufficient Data	Insufficient Data	Average or Better	N/A	N/A	Insufficient Data	Average or Better	N/A
Safety Emphasis Area?		**Yes**	**Weighted Average**	1.31	Above Average	High								

Table 11: Initial Safety Needs (Step 1 Continued): I-10/SR 85

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	% of Fatal + Incapacitating Injury Crashes Involving Trucks			% of Fatal + Incapacitating Injury Crashes Involving Motorcycles			% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
10-1	Rural 4 Lane Freeway with Daily Volume < 25,000	16	0-16	8%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10-2	Rural 4 Lane Freeway with Daily Volume < 25,000	6	16-22	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
10-3	Rural 4 Lane Freeway with Daily Volume < 25,000	10	22-32	15%	Average or Better	Low	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Medium
10-4	Rural 4 Lane Freeway with Daily Volume < 25,000	22	32-54	11%	Average or Better	None	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10-5	Rural 4 Lane Freeway with Daily Volume < 25,000	17	54-71	35%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10-6	Rural 4 Lane Freeway with Daily Volume < 25,000	11	71-82	17%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10-7	Rural 4 Lane Freeway with Daily Volume < 25,000	16	82-98	20%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
10-8	Rural 4 Lane Freeway with Daily Volume > 25,000	15	98-113	19%	Average or Better	High	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
85-9	2 or 3 or 4 Lane Divided Highway	6	155-149	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	High
85-10	2 or 3 or 4 Lane Divided Highway	11	149-138	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
85-11	2 or 3 or 4 Lane Divided Highway	15	138-123	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
85-12	2 or 3 Lane Undivided Highway	3	123-120	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
85-13	4 or 5 Lane Undivided Highway	2	120-118	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None
85-14	2 or 3 Lane Undivided Highway	3	120-123	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	None

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Table 12: Final Safety Needs (Step 2): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Hot Spots	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address need or other relevant issues identified in previous reports)
10-1	16	0-16	Low	None	Ehrenberg TI completed 10-8-14	Low	No programmed projects to address Safety Needs
10-2	6	16-22	Low	None	None	Low	West Quartzsite TI improvements programmed FY 16
10-3	10	22-32	Medium	MP 25 WB, MP 29 WB	None	Medium	No programmed projects identified to address Safety Needs
10-4	22	32-54	High	MP 49 WB, MP 35 EB, MP 37 EB, MP 42 EB	Pavement Preservation MP 42-52	High	Recent project does not reduce level of need; Pavement preservation MP 30-42 programmed FY 16
10-5	17	54-71	High	MP 61-62 EB	None	High	No programmed projects to address Safety Needs
10-6	11	71-82	High	MP 70-74 WB	None	High	Pavement preservation MP 71-81 programmed FY 19
10-7	16	82-98	High	MP 82 EB, MP 86-88 EB	None	High	395th Ave New TI programmed FY 20
10-8	15	98-113	Low	MP 107 EB, MP 109-112 EB, MP 111-112 WB	Pavement Rehab MP 80-112.5	Low	Recent project does not reduce level of need; Desert Creek Parkway TI programmed FY 20
85-9	6	155-149	High	MP 153 NB, MP 154 SB	None	High	Warner Street Bridge construction programmed FY 18
85-10	11	149-138	Low	None	None	Low	No programmed projects to address Safety Needs
85-11	15	138-123	None	None	Pavement Preservation under construction MP 121-131	None	No programmed projects to address Safety Needs
85-12	3	123-120	N/A	None	Pavement Preservation under construction MP 121-131	N/A	No programmed projects to address Safety Needs; Segment has insufficient data due to small number of crashes to determine accurate analysis
85-13	2	120-118	N/A	None	Pavement Preservation MP 117-120	N/A	No programmed projects to address Safety Needs; Segment has insufficient data due to small number of crashes to determine accurate analysis
85-14	3	120-123	N/A	None	None	N/A	No programmed projects to address Safety Needs; Segment has insufficient data due to small number of crashes to determine accurate analysis

6.3 Step 3: Safety Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors can be derived from:

- Hot spot crash summaries
- Previously completed safety-related projects
- District input on safety concerns
- Segment crash type summaries
- Section 6.2 of the 2010 Highway Safety Manual

Hot Spot Crash Summaries

Crash summaries were developed for each identified crash hot spot to identify observable crash patterns. These crash summaries are based on crashes of all severity levels (not just fatal and incapacitating injury) to provide more information for use in identifying crash patterns.

Previously Completed Safety-Related Projects

Recently completed safety-related projects may provide insight into previously identified contributing factors along the corridor. Some recently completed safety-related projects may already address some of the crash patterns evident in the crash analysis. Other safety-related projects completed before the crash analysis time period (i.e., more than five years old) may have exceeded their respective design life and rehabilitation or replacement could increase their effectiveness. Examples include rumble strips that are worn down or retroreflective materials that have lost their retro reflectivity.

District Input on Safety Concerns

ADOT maintenance personnel and MPO Staff provided information on locations where they had observed potential safety needs. Locations were defined by approximate milepost limits and assigned to the appropriate corridor segment. District safety concerns that corroborated the segment crash type summaries or crash hot spots summaries were noted.

Segment Crash Type Summaries

Crash frequencies for each possible crash type descriptor within each of the eight crash type summary categories were summarized for fatal and incapacitating injury crashes for each corridor segment that contained at least five crashes of that crash type descriptor (lower crash totals were not considered to have a sufficient sample size for analysis purposes). For an even more robust data set, crash types for crashes of all severity levels (not just fatal and incapacitating injury) can be reviewed to determine if crash patterns are readily identifiable. If this more detailed analysis is conducted, it is recommended that it only be conducted on segments with medium or high levels of need, or in segments with Hot Spots to minimize analysis effort.

The proportional occurrence of each possible crash type descriptor compared to the total number of fatal plus incapacitating injury crashes occurring in that respective segment was also calculated and expressed as a percentage. These segment-level crash type descriptor frequency percentages were then compared with the corresponding statewide crash type descriptor frequency percentages for all state highways with similar operating environments (as defined in the baseline corridor performance in Working Paper 2). Segment crash type descriptor frequency percentages that exceeded the corresponding statewide frequency percentage were identified as likely contributing factors to the level of need (illustrated with a red font). The crash type descriptors include the following components:

- First Harmful Event Type
  - Collision with Motor Vehicle
  - Overturning
  - Collision with Pedestrian
  - Collision with Pedalcyclist
  - Collision With Animal
  - Collision with Fixed Object
  - Collision with Non-Fixed Object
  - Vehicle Fire or Explosion
  - Other Non-Collision
  - Unknown
- Collision Type
  - Single Vehicle Collisions
  - Angle
  - Left Turn
  - Rear End
  - Head On
  - Sideswipe (same)
  - Sideswipe (opposite)
  - Rear to Side
  - Rear to Rear
  - Other
  - Unknown
- Violation or Behavior Type
  - No Improper Action
  - Speed too Fast for Conditions
  - Exceeded Lawful Speed
  - Failure to Yield Right-of-Way
  - Followed Too Closely
  - Ran Stop Sign
  - Disregarded Traffic Signal
  - Made Improper Turn
  - Drove in Opposing Lane
  - Faulty/Missing Equipment
  - Motorcycle Safety Equipment Use
  - Passed in No Passing Zone
  - Unsafe Lane Change
  - Failure to Keep in Proper Lane

  - Other Unsafe Passing
  - Inattention/Distraction
  - Electronic Communications Device
  - Other

- Type of Lighting Conditions
  - Daylight
  - Dawn
  - Dusk
  - Dark-Lighted
  - Dark-Unlighted
  - Dark-Unknown Lighting

- Type of Road Surface Conditions
  - Dry
  - Wet
  - Snow
  - Slush
  - Ice/Frost
  - Water (standing or moving)
  - Sand
  - Mud, Dirt, Gravel
  - Oil
  - Other
  - Unknown

- First Unit Event Description
  - Collision with Animal
  - Collision with Fixed Object
  - Ran Off the Road (Left)
  - Ran Off the Road (Right)
  - Crossed Centerline
  - Crossed Median
  - Collision with Pedestrian
  - Motor Vehicle in Transport
  - Overturn
  - Equipment Failure
  - Collision with Falling Object
  - Other Non-Collision
  - Other Non-Fixed Object
  - Unknown

- Driver Physical Condition
  - Under the Influence of Drugs or Alcohol
  - Fatigued/Fell Asleep
  - No Apparent Influence
  - Had Been Drinking
  - Medications
  - Illness
  - Physical Impairment
  - Other
  - Unknown

- Safety Device Usage
  - Shoulder and Lap Belt
  - Child Restraint System
  - None Used
  - Helmet Used
  - Air Bag Deployed/Shoulder-Lap Belt
  - Air Bag Deployed
  - Other
  - Unknown
  - Not Applicable
  - Lap Belt
  - Not Reported

Section 6.2 of the 2010 Highway Safety Manual

Section 6.2 of the 2010 Highway Safety Manual (HSM) provides potential contributing factors for corresponding crash types and patterns. Crash patterns within the corridor that match crash patterns in the HSM can reasonably be expected to have similar potential contributing factors to those listed in the HSM.

Safety Needs Contributing Factors

Likely contributing factors were developed based on the information obtained through the hot spot crash summaries, previously completed safety-related projects, District input on safety concerns, segment crash type summaries, and HSM potential contributing factors. These contributing factors provide guidance on the types of solutions that will likely promote improved safety performance. **Table 13** summarizes the likely contributing factors to safety needs on the I-10/SR 85 Corridor.

Table 13: Safety Needs Contributing Factors (Step 3): Segments 10-1 to 10-8

		10-1	10-2	10-3	10-4	10-5	10-6	10-7	10-8
Segment Length (miles)		16	6	10	22	17	11	16	15
Segment Milepost (MP)		0-16	16-22	22-32	32-54	54-71	71-82	82-98	98-113
Final Need		Low	Low	Medium	High	High	High	High	Low
Segment Crash Overview		4 Crashes were fatal 8 Crashes had incapacitating injuries 1 Crashes involve trucks 2 Crashes involve Motorcycles	2 Crashes were fatal 3 Crashes had incapacitating injuries 1 Crashes involve trucks 0 Crashes involve Motorcycles	3 Crashes were fatal 10 Crashes had incapacitating injuries 2 Crashes involve trucks 1 Crashes involve Motorcycles	13 Crashes were fatal 24 Crashes had incapacitating injuries 4 Crashes involve trucks 0 Crashes involve Motorcycles	9 Crashes were fatal 17 Crashes had incapacitating injuries 9 Crashes involve trucks 2 Crashes involve Motorcycles	6 Crashes were fatal 12 Crashes had incapacitating injuries 3 Crashes involve trucks 1 Crashes involve Motorcycles	15 Crashes were fatal 10 Crashes had incapacitating injuries 5 Crashes involve trucks 2 Crashes involve Motorcycles	12 Crashes were fatal 14 Crashes had incapacitating injuries 5 Crashes involve trucks 2 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	**First Harmful Event Type**	50% Involve Collision with Motor Vehicle 25% Involve Collision with Fixed Object 17% Involve Other Non-Collision	60% Involve Collision with Motor Vehicle 20% Involve Overturning 20% Involve Collision with Non-Fixed Object	54% Involve Overturning 38% Involve Collision with Motor Vehicle 8% Involve Other Non-Collision	57% Involve Overturning 22% Involve Collision with Motor Vehicle 14% Involve Collision with Fixed Object	46% Involve Overturning 35% Involve Collision with Motor Vehicle 12% Involve Collision with Fixed Object	72% Involve Overturning 22% Involve Collision with Motor Vehicle 6% Involve Collision with Non-Fixed Object	54% Involve Overturning 17% Involve Collision with Motor Vehicle 13% Involve Collision with Fixed Object	55% Involve Overturning 30% Involve Collision with Motor Vehicle 10% Involve Collision with Fixed Object
	Collision Type	42% Involve Single Vehicle 25% Involve Rear End 25% Involve Sideswipe (same)	60% Involve Rear End 20% Involve Single Vehicle 20% Involve Angle	61% Involve Single Vehicle 15% Involve Rear End 15% Involve Sideswipe (same)	76% Involve Single Vehicle 24% Involve Rear End	62% Involve Single Vehicle 27% Involve Rear End 8% Involve Sideswipe (same)	72% Involve Single Vehicle 22% Involve Rear End 6% Involve Head On	67% Involve Single Vehicle 17% Involve Other 8% Involve Sideswipe (same)	65% Involve Single Vehicle 20% Involve Rear End 10% Involve Other
	Violation or Behavior	33% Involve Inattention/Distraction 17% Involve No Improper Action 8% Involve Speed too Fast for Conditions	40% Involve Failure to Keep in Proper Lane 20% Involve No Improper Action 20% Involve Speed too Fast for Conditions	54% Involve Speed too Fast for Conditions 15% Involve Inattention/Distraction 8% Involve No Improper Action	57% Involve Speed too Fast for Conditions 14% Involve Unknown 8% Involve No Improper Action	46% Involve Speed too Fast for Conditions 15% Involve No Improper Action 12% Involve Inattention/Distraction	22% Involve No Improper Action 22% Involve Inattention/Distraction 17% Involve Speed too Fast for Conditions	29% Involve No Improper Action 29% Involve Speed too Fast for Conditions 17% Involve Unknown	45% Involve Speed too Fast for Conditions 20% Involve No Improper Action 15% Involve Unknown
	Lighting Conditions	75% Occur in Daylight Conditions 25% Occur in Dark-Unlighted Conditions	80% Occur in Daylight Conditions 20% Occur in Dark-Unlighted Conditions	69% Occur in Daylight Conditions 23% Occur in Dark-Unlighted Conditions 8% Occur in Dawn Conditions	51% Occur in Daylight Conditions 35% Occur in Dark-Unlighted Conditions 11% Occur in Dawn Conditions	46% Occur in Daylight Conditions 38% Occur in Dark-Unlighted Conditions 8% Occur in Dawn Conditions	61% Occur in Daylight Conditions 33% Occur in Dark-Unlighted Conditions 6% Occur in Dawn Conditions	58% Occur in Daylight Conditions 29% Occur in Dark-Unlighted Conditions 8% Occur in Dawn Conditions	65% Occur in Daylight Conditions 30% Occur in Dark-Unlighted Conditions 5% Occur in Dawn Conditions
	Surface Conditions	100% Involve Dry Conditions	100% Involve Dry Conditions	85% Involve Dry Conditions 15% Involve Wet Conditions	100% Involve Dry Conditions	100% Involve Dry Conditions	100% Involve Dry Conditions	96% Involve Dry Conditions 4% Involve Unknown Conditions	100% Involve Dry Conditions
	First Unit Event	50% Involve a first unit event of Motor Vehicle in Transport 33% Involve a first unit event of Ran Off the Road (Left) 8% Involve a first unit event of Collision with Fixed Object	60% Involve a first unit event of Motor Vehicle in Transport 20% Involve a first unit event of Ran Off the Road (Left) 20% Involve a first unit event of Ran Off the Road (Right)	38% Involve a first unit event of Ran Off the Road (Left) 23% Involve a first unit event of Motor Vehicle in Transport 15% Involve a first unit event of Ran Off the Road (Right)	30% Involve a first unit event of Ran Off the Road (Left) 30% Involve a first unit event of Ran Off the Road (Right) 19% Involve a first unit event of Motor Vehicle in Transport	31% Involve a first unit event of Motor Vehicle in Transport 27% Involve a first unit event of Equipment Failure 23% Involve a first unit event of Ran Off the Road (Left)	39% Involve a first unit event of Ran Off the Road (Left) 33% Involve a first unit event of Equipment Failure 22% Involve a first unit event of Motor Vehicle in Transport	33% Involve a first unit event of Ran Off the Road (Left) 21% Involve a first unit event of Equipment Failure 13% Involve a first unit event of Ran Off the Road (Right)	30% Involve a first unit event of Ran Off the Road (Left) 30% Involve a first unit event of Motor Vehicle in Transport 20% Involve a first unit event of Equipment Failure
	Driver Physical Condition	42% No Apparent Influence 33% Unknown 17% Fatigued/Fell Asleep	60% Unknown 20% Under the Influence of Drugs or Alcohol 20% Fatigued/Fell Asleep	69% No Apparent Influence 23% Unknown 8% Under the Influence of Drugs or Alcohol	51% No Apparent Influence 24% Fatigued/Fell Asleep 11% Under the Influence of Drugs or Alcohol	50% No Apparent Influence 27% Unknown 15% Fatigued/Fell Asleep	39% No Apparent Influence 39% Unknown 11% Under the Influence of Drugs or Alcohol	50% Unknown 33% No Apparent Influence 8% Under the Influence of Drugs or Alcohol	60% No Apparent Influence 25% Unknown 10% Under the Influence of Drugs or Alcohol
	Safety Device Usage	50% Shoulder And Lap Belt Used 25% Air Bag Deployed/Shoulder-Lap Belt 17% Helmet Used	40% Air Bag Deployed/Shoulder-Lap Belt 20% Shoulder And Lap Belt Used 20% None Used	54% Shoulder And Lap Belt Used 23% None Used 8% Helmet Used	68% Shoulder And Lap Belt Used 19% None Used 14% Air Bag Deployed/Shoulder-Lap Belt	69% Shoulder And Lap Belt Used 15% None Used 8% Helmet Used	72% Shoulder And Lap Belt Used 11% None Used 6% Helmet Used	71% Shoulder And Lap Belt Used 13% None Used 8% Helmet Used	70% Shoulder And Lap Belt Used 20% None Used 5% Helmet Used
Hot Spot Crash Summaries				MP 25 WB, MP 29 WB	MP 49 WB, MP 35 EB, MP 37 EB, MP 42 EB	MP 61-62 EB	MP 70-74 WB	MP 82 EB, MP 86-88 EB	MP 107 EB, MP 109-112 EB, MP 111-112 WB
Previously Completed Safety-Related Projects		Ehrenberg TI completed 10-8-14			Pavement Preservation MP 42-52				Pavement Rehab MP 80-112.5
District Interviews/Discussions									
Contributing Factors		• Narrow shoulder • Driver inattention/distraction • Low visibility at night • Excessive speed • Narrow median without concrete/cable barrier	• Drivers' intoxication • Driver fatigue • Inadequate lighting • Driver inattention/distraction	• Excessive speed • Narrow shoulder • Slippery pavement • Low visibility at night • Driver inattention/distraction • Speed too fast for the condition	• Driver fatigue • Excessive speed • Low visibility at night • Obstruction near roadway • Narrow shoulder • Drivers' intoxication • Speed too fast for the condition	• Excessive speed • Driver inattention/distraction • Low visibility at night • Speed too fast for the condition • Inadequate roadside barrier	• Excessive speed • Low visibility at night • Narrow shoulder • Driver inattention/distraction	• Excessive speed • Speed too fast for the condition • Low visibility at night • Narrow shoulder • Inadequate roadside barrier	• Excessive speed • Low visibility at night • Narrow shoulder • Speed too fast for the condition

Table 13: Safety Needs Contributing Factors (Step 3 Continued): Segments 85-9 to 85-14

		85-9	85-10	85-11	85-12	85-13	85-14	Corridor-Wide Crash Characteristics
Segment Number								
Segment Length (miles)		6	11	15	3	2	3	
Segment Milepost (MP)		155-149	149-138	138-123	123-120	120-118	120-123	
Final Need		High	Low	None	N/A	N/A	N/A	
Segment Crash Overview		**6** Crashes were fatal **9** Crashes had incapacitating injuries **2** Crashes involve trucks **0** Crashes involve Motorcycles	**2** Crashes were fatal **0** Crashes had incapacitating injuries **0** Crashes involve trucks **0** Crashes involve Motorcycles	**1** Crashes were fatal **2** Crashes had incapacitating injuries **0** Crashes involve trucks **0** Crashes involve Motorcycles	**0** Crashes were fatal **1** Crashes had incapacitating injuries **0** Crashes involve trucks **0** Crashes involve Motorcycles	**0** Crashes were fatal **2** Crashes had incapacitating injuries **0** Crashes involve trucks **0** Crashes involve Motorcycles	**0** Crashes were fatal **0** Crashes had incapacitating injuries **0** Crashes involve trucks **0** Crashes involve Motorcycles	**73** Crashes were fatal **112** Crashes had incapacitating injuries **32** Crashes involve trucks **10** Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	**First Harmful Event Type**	87% Involve Collision with Motor Vehicle 13% Involve Overturning	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	47% Involve Overturning 34% Involve Collision with Motor Vehicle 10% Involve Collision with Fixed Object
	Collision Type	73% Involve Angle 13% Involve Single Vehicle 7% Involve Left Turn	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	61% Involve Single Vehicle 18% Involve Rear End 7% Involve Angle
	Violation or Behavior	40% Involve Ran Stop Sign 27% Involve Failure to Yield Right-of-Way 13% Involve Unknown	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	35% Involve Speed too Fast for Conditions 15% Involve No Improper Action 12% Involve Inattention/Distraction
	Lighting Conditions	60% Occur in Daylight Conditions 40% Occur in Dark-Unlighted Conditions	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	57% Occur in Daylight Conditions 34% Occur in Dark-Unlighted Conditions 7% Occur in Dawn Conditions
	Surface Conditions	87% Involve Dry Conditions 13% Involve Wet Conditions	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	96% Involve Dry Conditions 4% Involve Wet Conditions 1% Involve Unknown Conditions
	First Unit Event	80% Involve a first unit event of Motor Vehicle in Transport 7% Involve a first unit event of Ran Off the Road (Left) 7% Involve a first unit event of Ran Off the Road (Right)	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	30% Involve a first unit event of Ran Off the Road (Left) 30% Involve a first unit event of Motor Vehicle in Transport 17% Involve a first unit event of Equipment Failure
	Driver Physical Condition	47% No Apparent Influence 40% Unknown 7% Under the Influence of Drugs or Alcohol	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	46% No Apparent Influence 30% Unknown 12% Fatigued/Fell Asleep
	Safety Device Usage	60% Shoulder And Lap Belt Used 40% None Used	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	65% Shoulder And Lap Belt Used 16% None Used 8% Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries		MP 153 NB, MP 154 SB						
Previously Completed Safety-Related Projects				Pavement Preservation under construction MP 121-131	Pavement Preservation under construction MP 121-131	Pavement Preservation MP 117-120		
District Interviews/Discussions		NB SR 85 to EB I-10 movement tends to back up onto SR 85 and create incidents and delay						
Contributing Factors		• Drivers running stop/yield signs • Slippery pavement • Narrow shoulder • Low visibility at night • High speed on approach • Unexpected crossing traffic	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	

7.0 FREIGHT PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the I-10/SR 85 Corridor for the Freight Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

7.1 Step 1: Initial Freight Needs

The baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the I-10/SR 85 Corridor were used to determine the initial freight needs, as described in Section 2.1. The freight data used to calculate baseline performance was provided by ADOT for 2014 for the existing travel time data, 2010-2014 for the closure data, and 2014 for bridge clearance data.

Step 1 uses the scores for the Freight Index primary performance measure and four secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The four secondary performance measures are Directional Truck Travel Time Index (TTTI), Directional Truck Planning Time Index (TPTI), Directional Closure Duration, and Bridge Vertical Clearance.

The performance scores, performance objectives, and initial levels of need for each freight performance measure and for all freight performance measures combined are shown in **Table 14**.

For the Freight Index, zero segments report a high level of need; however Segments 85-9, 85-11, 85-13, and 85-14 report a medium level of need. For Directional TTTI, Northbound Segment 85-13 has a medium level of need, and Southbound Segment 85-14 has a medium level of need. For Directional TPTI, Northbound Segments 85-10, 85-13, and 85-14 report a high level of need; Southbound Segments 85-9 and 85-11 report a high level of need, and Southbound Segment 10-1 reports a medium level of need. For Directional Closure Duration, Northbound Segment 10-7 has a high level of need, and Southbound Segment 85-9 has a high level of need; Northbound Segment 10-6 and Southbound Segment 10-4 both report a medium level of need. For Bridge Vertical Clearance, zero segments report a high level of need; however Segments 10-1, 10-2, 10-3, 10-4, 10-6, and 10-8 report a medium level of need. For all freight performance measures combined, Segments 85-13 and 85-14 report a high level of initial need, and Segments 10-1 and 85-11 report a medium level of initial need.

7.2 Step 2: Final Freight Needs

Once the initial freight needs by segment for the I-10/SR 85 Corridor were established, they were then refined in Step 2 as described in Section 2.2 to more accurately reflect existing needs. An evaluation of vertical clearance hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 15**.

Vertical Clearance Hot Spots

Segments 10-4 and 10-8 contain vertical clearance hot spots, which are bridges that provide less than 16.25 feet of vertical clearance above the corridor mainline through lanes and that cannot be ramped around. There are two bridges with vertical clearance hot spots; Ramsey Mine Rd UP at MP 33.78 and 355th Ave UP at MP 101.4. The locations of bridges with vertical clearance hot spots are listed in **Table 15**. Since there was already initial need on the segments, these hot spots did not increase the need of the segment.

Recently Completed and Under-Construction Freight Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a freight need on a corridor segment.

Segment 10-1 contains a recently completed project which would supersede the freight condition data, as shown in **Table 15**. The Ehrenberg POE Improvement is under construction. The level of need in Segment 10-1 remained Medium despite the POE improvement, so no adjustment was made to the need level of that segment to account for the recently completed project.

Planned or Programmed Projects

Information was noted in **Table 15** on freight-related planned and programmed projects and other issues identified in previous reports in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 14: Initial Freight Needs (Step 1): I-10/SR 85

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTI (trucks only)					Directional PTI (trucks only)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							NB/WB	EB/SB		NB/WB	EB/SB	NB/WB	EB/SB		NB/WB	EB/SB
10-1	Uninterrupted	0-16	16	0.71	Fair or Better	Low	1.14	1.19	Fair or Better	None	None	1.36	1.46	Fair or Better	None	Medium
10-2	Uninterrupted	16-22	6	0.89	Fair or Better	None	1.05	1.04	Fair or Better	None	None	1.13	1.11	Fair or Better	None	None
10-3	Uninterrupted	22-32	10	0.89	Fair or Better	None	1.05	1.04	Fair or Better	None	None	1.14	1.10	Fair or Better	None	None
10-4	Uninterrupted	32-54	22	0.90	Fair or Better	None	1.04	1.05	Fair or Better	None	None	1.09	1.12	Fair or Better	None	None
10-5	Uninterrupted	54-71	17	0.87	Fair or Better	None	1.06	1.06	Fair or Better	None	None	1.17	1.13	Fair or Better	None	None
10-6	Uninterrupted	71-82	11	0.90	Fair or Better	None	1.06	1.05	Fair or Better	None	None	1.11	1.12	Fair or Better	None	None
10-7	Uninterrupted	82-98	16	0.88	Fair or Better	None	1.05	1.06	Fair or Better	None	None	1.13	1.15	Fair or Better	None	None
10-8	Uninterrupted	98-113	15	0.90	Fair or Better	None	1.04	1.04	Fair or Better	None	None	1.11	1.12	Fair or Better	None	None
85-9	Uninterrupted	155-149	6	0.66	Fair or Better	Medium	1.00	1.07	Fair or Better	None	None	1.40	1.64	Fair or Better	Low	High
85-10	Uninterrupted	149-138	11	0.73	Fair or Better	Low	1.11	1.00	Fair or Better	None	None	1.71	1.03	Fair or Better	High	None
85-11	Uninterrupted	138-123	15	0.65	Fair or Better	Medium	1.06	1.15	Fair or Better	None	None	1.15	1.94	Fair or Better	None	High
85-12	Interrupted	123-120	3	0.60	Fair or Better	None	1.00	1.19	Fair or Better	None	None	1.00	2.35	Fair or Better	None	None
85-13	Interrupted	120-118	2	0.14	Fair or Better	Medium	2.17	1.47	Fair or Better	Medium	None	12.08	2.59	Fair or Better	High	None
85-14	Interrupted	120-123	3	0.17	Fair or Better	Medium	1.27	1.91	Fair or Better	None	Medium	8.04	3.82	Fair or Better	High	None
Emphasis Area?	Yes	**Weighted Average**		0.80	Good											

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Closure Duration (hours/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
				NB/WB	EB/SB		NB/WB	EB/SB				
10-1	Uninterrupted	0-16	16	50.47	25.03	Fair or Better	None	None	16.11	Fair or Better	Medium	Medium
10-2	Uninterrupted	16-22	6	43.57	4.80	Fair or Better	None	None	15.96	Fair or Better	Medium	Low
10-3	Uninterrupted	22-32	10	8.78	60.66	Fair or Better	None	None	16.14	Fair or Better	Medium	Low
10-4	Uninterrupted	32-54	22	35.48	136.64	Fair or Better	None	Medium	15.90	Fair or Better	Medium	Low
10-5	Uninterrupted	54-71	17	42.00	59.85	Fair or Better	None	None	16.25	Fair or Better	Low	Low
10-6	Uninterrupted	71-82	11	100.12	97.78	Fair or Better	Medium	Low	16.00	Fair or Better	Medium	Low
10-7	Uninterrupted	82-98	16	197.56	36.99	Fair or Better	High	None	16.58	Fair or Better	None	Low
10-8	Uninterrupted	98-113	15	44.39	31.35	Fair or Better	None	None	15.92	Fair or Better	Medium	Low
85-9	Uninterrupted	155-149	6	17.87	187.62	Fair or Better	None	High	No UP	Fair or Better	None	High
85-10	Uninterrupted	149-138	11	93.75	0.00	Fair or Better	Low	None	No UP	Fair or Better	None	Low
85-11	Uninterrupted	138-123	15	21.20	4.17	Fair or Better	None	None	No UP	Fair or Better	None	Medium
85-12	Interrupted	123-120	3	30.67	5.33	Fair or Better	None	None	No UP	Fair or Better	None	None
85-13	Interrupted	120-118	2	*No Data*	*No Data*	Fair or Better	N/A	N/A	16.63	Fair or Better	None	High
85-14	Interrupted	120-123	3	*No Data*	*No Data*	Fair or Better	N/A	N/A	No UP	Fair or Better	None	High

Table 15: Final Freight Needs (Step 2): I-10/SR 85

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address needs or other relevant issues identified in previous reports)
10-1	16	0-16	Medium	None	Ehrenberg POE Improvements under construction	Medium	Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-2	6	16-22	Low	None	None	Low	Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-3	10	22-32	Low	None	None	Low	Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-4	22	32-54	Low	Ramsey Mine Rd UP, #1202, MP 33.78	None	Low	Programmed: Pavement Preservation MP 30-42 will re-profile roadway to increase clearance – FY16 Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-5	17	54-71	Low	None	None	Low	Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-6	11	71-82	Low	None	None	Low	Planned: Widen mainline to six lanes - I-10 Multimodal Corridor Profile Study
10-7	16	82-98	Low	None	None	Low	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors
10-8	15	98-113	Low	355th Ave UP, #1647, MP 101.4	None	Low	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors
85-9	6	155-149	High	None	None	High	Planned: Widen SR 85 to six lane freeway - MAG 2035 RTP NB/SB DMS (MP 152/153) - AZ Statewide DMS Plan
85-10	11	149-138	Low	None	None	Low	Planned: Widen SR 85 to six lane freeway - MAG 2035 RTP
85-11	15	138-123	Medium	None	None	Medium	Planned: Widen SR 85 to six lane freeway - MAG 2035 RTP
85-12	3	123-120	None	None	None	None	Planned: Widen SR 85 to six lane freeway - MAG 2035 RTP SB DMS (MP 120) - AZ Statewide DMS Plan
85-13	2	120-118	High	None	None	High	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors
85-14	3	120-123	High	None	None	High	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors

7.3 Step 3: Freight Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors include:

- Roadway variables
- Traffic variables
- Relevant freight-related existing infrastructure
- Closure type
- Non-actionable conditions

Roadway Variables

Roadway variables include functional classification, environmental type (e.g., urban, rural), terrain, number of lanes, speed limit, presence of auxiliary lanes, if a roadway is divided or non-divided, and how often passing is not allowed. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include urban, fringe urban, and rural. Capacity thresholds differ depending on the environmental type as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- The number of lanes in each direction indicates how many general purpose through lanes exist.
- The speed limit indicates the posted speed limit.
- The presence of auxiliary lanes for turning, weaving, or passing can improve mobility performance by maintaining more consistent speeds in mainline through lanes.
- A roadway is considered divided if it has a raised or depressed median separating the directions of traffic that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- The presence of no-passing zones restricts the movement of vehicles around slower-moving vehicles.

Traffic Variables

Traffic variables include existing and future level of service (LOS), percent (%) trucks, and the buffer index (difference between PTI and TTI). The existing and future LOS, percentage of trucks, and buffer index can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

Existing and Future LOS

The existing and future LOS provide a letter "grade" between "A" and "F" for mobility that is generally reflective of Existing and Future V/C calculations. LOS values of "A", "B", and "C" are generally considered highly acceptable. A LOS value of "D" is generally considered moderately acceptable. LOS values of "E" and "F" are generally considered unacceptable.

Truck Traffic

The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. The truck volume on a corridor can impact overall mobility based on truck travel speed, corridor grades, required inspection points and number of lanes.

Buffer Index

The Buffer Index is calculated by subtracting the segment level TTI value (ratio of peak hour speed to free flow speed) from the segment level PTI value (95th percentile speed). The TTI and PTI values were determined in Working Paper 2. The buffer index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of a corridor.

Freight-Related Infrastructure

Freight related infrastructure refers to devices or features at specific locations that influence freight performance. Examples include Dynamic Message Signal (DMS), passing lanes, climbing lanes, Point of Entry (POE), weigh stations, rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of freight-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor freight performance that cannot be addressed through an engineered solution. Examples include border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Freight Needs Contributing Factors

Table 16 summarizes the potential contributing factors to freight needs on the I-10/SR 85 Corridor.

Table 16: Freight Needs Contributing Factors (Step 3): I-10/SR 85

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Freight Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB/EB Buffer Index (TPTI-TTTI)	SB/WB Buffer Index (TPTI-TTTI)	
10-1	0-16	16	Medium	Interstate	Rural	Level	2	72.2	No	Divided	0%	A-C	A-C	26%	0.22	0.27	Ehrenberg Port of Entry on I-10, DMS MP 15.60, Weigh-in-Motion MP 2.30
10-2	16-22	6	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.08	0.07	None
10-3	22-32	10	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.09	0.06	None
10-4	32-54	22	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.05	0.07	DMS MP 49.40
10-5	54-71	17	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.11	0.07	None
10-6	71-82	11	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.05	0.07	None
10-7	82-98	16	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.08	0.09	None
10-8	98-113	15	Low	Interstate	Rural	Level	2	75	No	Divided	0%	A-C	A-C	26%	0.07	0.08	DMS MP 110.30
85-9	155-149	6	High	State Highway	Fringe Urban	Level	2	52.7	No	Divided	0%	A-C	D	19%	0.40	0.57	None
85-10	149-138	11	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A-C	21%	0.60	0.03	None
85-11	138-123	15	Medium	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A-C	26%	0.09	0.79	None
85-12	123-120	3	None	State Highway	Rural	Level	1	43.2	No	Divided	50%	A-C	A-C	22%	0.00	1.16	None
85-13	120-118	2	High	State Highway	Fringe Urban	Level	2	35	No	Divided	0%	A-C	A-C	7%	9.91	1.12	None
85-14	120-123	3	High	State Highway	Fringe Urban	Level	1	49.5	No	Divided	10%	A-C	A-C	15%	6.77	1.91	None

Table 16: Freight Needs Contributing Factors (Step 3) (continued): I-10/SR 85

Segment	Mileposts (MP)	Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total # of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
10-1	0-16	16	Medium	14	14	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- Ehrenberg Weigh-in-motion station slows traffic as all trucks must merge in and out - Elevated TPTI scores result in elevated needs - Elevated number of closures in the WB direction
10-2	16-22	6	Low	6	6	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- 100% of closures were related to incidents/accidents
10-3	22-32	10	Low	10	13	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- 100% of closures were related to incidents/accidents
10-4	32-54	22	Low	22	25	100%	0	0%	0	0%	None	Programmed: Pavement Preservation MP 30-42 will increase clearance – FY16 Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	-Ramsey Mine Rd UP cannot ramp around
10-5	54-71	17	Low	17	19	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- 100% of closures were related to incidents/accidents
10-6	71-82	11	Low	11	16	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- 100% of closures were related to incidents/accidents
10-7	82-98	16	Low	16	25	100%	0	0%	0	0%	None	Planned: Widen Mainline to six lanes- I-10 Multimodal Corridor Profile Study	- 100% of closures were related to incidents/accidents
10-8	98-113	15	Low	15	17	100%	0	0%	0	0%	None	Planned: Widen Mainline to eight lanes plus HOV- Key Commerce Corridors	-355th Ave UP, #1647, MP 101.4
85-9	155-149	6	High	6	24	100%	0	0%	0	0%	None	Planned: Widen Mainline to eight lanes plus HOV – Key Commerce Corridors	- Grade on the I-10 ramp at the junction slows trucks - Elevated TPTI values result in high need
85-10	149-138	11	Low	11	4	100%	0	0%	0	0%	None	Planned: Widen SR 85 to six lane freeway – MAG 2035 RTP NB/SB DMS (MP 152/153) – AZ Statewide DMS Plan	- 100% of closures were related to incidents/accidents
85-11	138-123	15	Medium	15	3	100%	0	0%	0	0%	None	Planned: Widen SR 85 to six lane freeway – MAG 2035 RTP	- 100% of closures were related to incidents/accidents - Elevated TPTI values result in high need
85-12	123-120	3	None	3	4	100%	0	0%	0	0%	None	Planned: Widen SR 85 to six lane freeway – MAG 2035 RTP SB DMS (MP 120) – AZ Statewide DMS Plan	- 100% of closures were related to incidents/accidents
85-13	120-118	2	High	15	0	0%	0	0%	0	0%	None	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors	-Elevated TPTI and TTTI values result in high need
85-14	120-123	3	High	3	0	0%	0	0%	0	0%	None	Planned: Widen mainline to eight lanes plus HOV - Key Commerce Corridors	- Elevated NB TPTI result in high need. May be attributed to construction activity.

8.0 SEGMENT REVIEW (STEP 4)

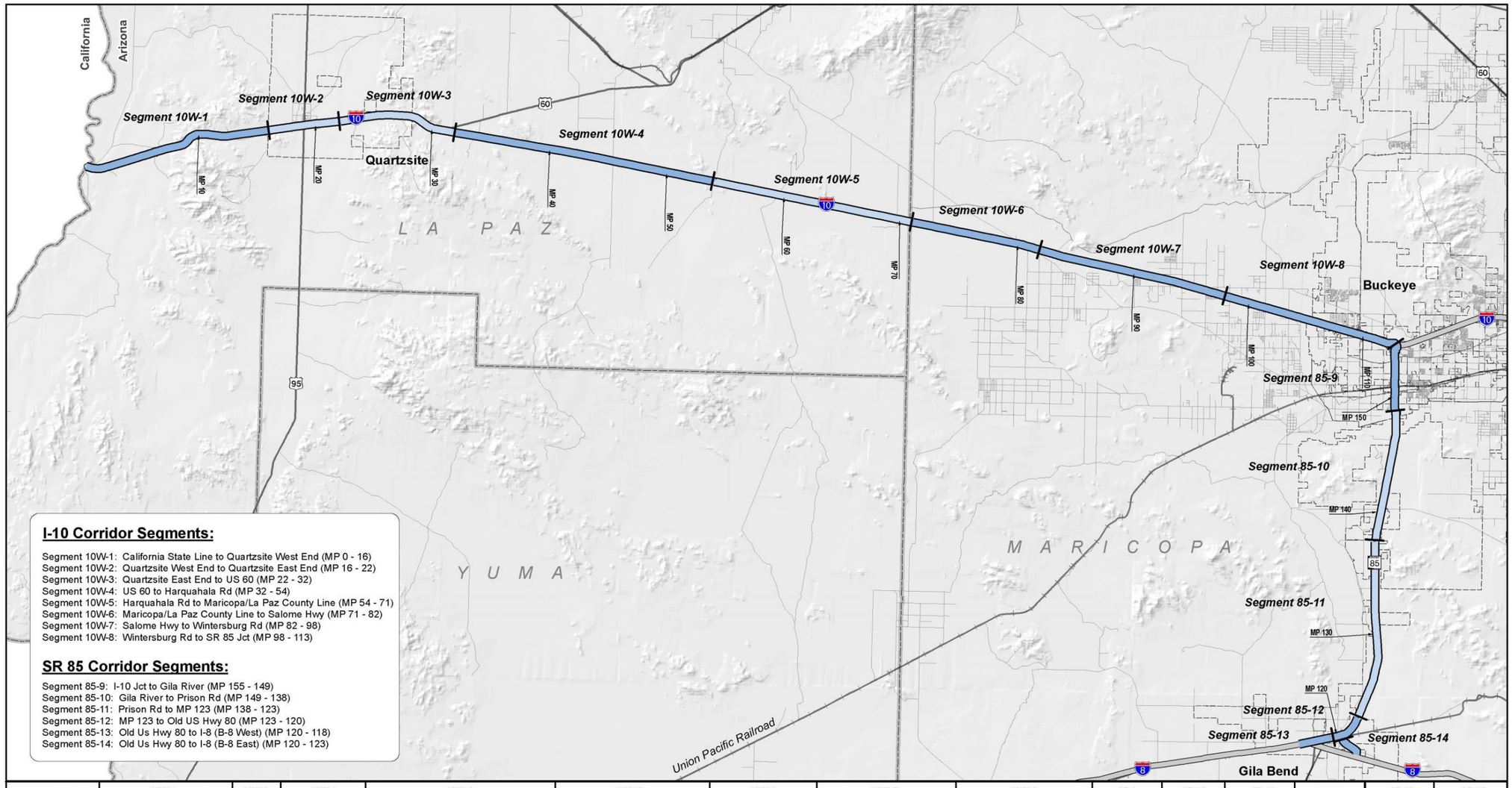
As part of Step 4, the final needs results for each segment were combined to determine the average level of need for each segment along the I-10/SR 85 Corridor, as described in Section 2.4. During the Corridor Goals and Objectives development process for I-10/SR 85, the Mobility, Safety, and Freight Performance Areas were identified as Emphasis Areas. Therefore, a weighting factor of 1.50 was applied to those performance area needs. A summary of the segment needs is shown in **Table 17** along with the resulting average need. These results are intended for use to compare the level of need across corridors.

Table 17: Segment Needs Summary: I-10/SR 85 Corridor

Performance Area	10W-1	10W-2	10W-3	10W-4	10W-5	10W-6	10W-7	10W-8	85-9	85-10	85-11	85-12	85-13	85-14
	MP 0-16	MP 16-22	MP 22-32	MP 32-54	MP 54-71	MP 71-82	MP 82-98	MP 98-113	MP 155-149	MP 149-139	MP 138-123	MP 123-120	MP 120-118	MP 120-123
Pavement	Low	None*	None*	Low	None*	Low	None*	None*	None*	Low	None*	None*	None*	None*
Bridge	Medium	Low	Low	Low	None*	None*	None*	Low	None*	None*	None*	Medium	Medium	None*
Mobility	Low	None*	None*	None*	None*	Low	Low	Low	Low	Low	Low	High	Low	High
Safety	Low	Low	Medium	High	High	High	High	Medium	High	Low	None*	N/A	N/A	N/A
Freight	Medium	Low	Low	Low	Low	Low	Low	Low	High	Low	Medium	None*	High	High
Average Need (0-3)	**1.38**	**0.62**	**0.85**	**1.23**	**0.92**	**1.31**	**1.15**	**1.08**	**1.62**	**0.85**	**0.69**	**1.30**	**1.60**	**1.80**

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Figure 7: Needs Summary: I-10/SR 85



I-10 Corridor Segments:

Segment 10W-1: California State Line to Quartzsite West End (MP 0 - 16)
Segment 10W-2: Quartzsite West End to Quartzsite East End (MP 16 - 22)
Segment 10W-3: Quartzsite East End to US 60 (MP 22 - 32)
Segment 10W-4: US 60 to Harquahala Rd (MP 32 - 54)
Segment 10W-5: Harquahala Rd to Maricopa/La Paz County Line (MP 54 - 71)
Segment 10W-6: Maricopa/La Paz County Line to Salome Hwy (MP 71 - 82)
Segment 10W-7: Salome Hwy to Wintersburg Rd (MP 82 - 98)
Segment 10W-8: Wintersburg Rd to SR 85 Jct (MP 98 - 113)

SR 85 Corridor Segments:

Segment 85-9: I-10 Jct to Gila River (MP 155 - 149)
Segment 85-10: Gila River to Prison Rd (MP 149 - 138)
Segment 85-11: Prison Rd to MP 123 (MP 138 - 123)
Segment 85-12: MP 123 to Old US Hwy 80 (MP 123 - 120)
Segment 85-13: Old Us Hwy 80 to I-8 (B-8 West) (MP 120 - 118)
Segment 85-14: Old Us Hwy 80 to I-8 (B-8 East) (MP 120 - 123)

Segment Number and Mileposts	10W-1	10W-2	10W-3	10W-4	10W-5	10W-6	10W-7	10W-8	85-9	85-10	85-11	85-12	85-13	85-14
	MP 0 - 16	MP 16 - 22	MP 22 - 32	MP 32 - 54	MP 54 - 71	MP 71 - 82	MP 82 - 98	MP 98 - 113	MP 155 - 149	MP 149 - 138	MP 138 - 123	MP 123 - 120	MP120 - 118	MP120 - 123
Average Need	1.38	0.62	0.85	1.23	0.92	1.31	1.15	1.08	1.91	0.85	0.82	1.30	1.60	1.80

I-10/SR 85 Corridor Profile Study: California State Line to I-8
Needs Summary

N
MILES
0 5 10 20

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

Level of Need
Low
Medium
High

9.0 CORRIDOR NEEDS (STEP 5)

Step 5 translates the performance-based needs into corridor needs that are "actionable." These needs can facilitate development of solutions (projects, initiatives, countermeasures, and programs) to improve corridor performance through strategic investments in preserving, modernizing, and/or expanding the corridor. Corridor needs were developed through a segment-by-segment review of needs and contributing factors. This review also identified overlapping, common, and contrasting needs across performance areas.

Figure 8 shows the corridor need locations for each performance area and programmed projects for fiscal year (FY) 2016-2020. Programmed projects have not yet been constructed and may address identified needs or be modified as part of the development of strategic investments.

For additional detail on specific needs by location, refer to the information in Step 3.

9.1 Description of Needs by Performance Area

Pavement Needs

The Pavement Performance Area is not an emphasis area for I-10/SR 85; however four of fourteen segments of the I-10/SR 85 Corridor exhibit a low level of need in Pavement Performance.

Pavement hot spot failure needs were identified along the corridor, including areas that have levels of historical investment. Hot spots that will be addressed by a programmed project are not included.

Hot Spot Failures:

- EB MP 12-13
- WB MP 9-10, 11-12, and 15-16
- NB MP 143-146

Bridge Needs

The Bridge Performance Area is not an emphasis area for I-10/SR 85. Three of fourteen segments of the I-10/SR 85 Corridor exhibit "Medium" level of need in Bridge Performance. Four of the fourteen segments exhibit a "Low" level of need. The segments include:

Medium:

- Segment 10-1 MP 0-16
- Segment 85-12 MP 123-120
- Segment 85-13 MP 120-118

Low:

- Segment 10-2 MP 16-22
- Segment 10-3 MP 22-32
- Segment 10-4 MP 32-54
- Segment 10-8 MP 98-113

One of fifty-nine bridges exhibit historical issues:

- Tom Wells Rd TI UP MP 5.84

There are two programmed projects for bridges.

- West Quartzsite TI Improvements programmed FY 16
- New Bridge Construction at Warner Street (MP 153) programmed FY 20

Key contributing factors/needs are summarized below

- Ehrenberg Bridge (MP 1.01) is not considered a hot spot due to Evaluation rating
- Segment 10-3 has no bridges with current ratings less than 6, however the percentage of functionally obsolete bridges in segment cause 'low' bridge need score.
- Segment 85-12 has only one bridge, and the structural evaluation rating of 5 causes 'medium' need score.

Mobility Needs

The Mobility Performance Area is an emphasis area for I-10/SR 85. The ten segments listed below exhibit need in Mobility Performance:

High:

- Segment 85-12 MP 123-120
- Segment 85-14 MP 120-123

Low:

- Segment 10-1 MP 0-16
- Segment 10-6 MP 71-82
- Segment 10-7 MP 82-98
- Segment 10-8 MP 98-113
- Segment 85-9 MP 155-149
- Segment 85-10 MP 149-138
- Segment 85-11 MP 138-123
- Segment 85-13 MP 120-118

Mobility needs are summarized below that specify focus areas for the I-10/SR 85 corridor.

- 100% of closures on I-10/SR 85 are due to incidents/accidents
- Segment 85-12 exhibits an elevated mobility index score due to current and future V/C
- Segment 85-13 is an arterial roadway that acts as Main Street in Gila Bend
- Segment 85-14 exhibits an elevated mobility index score due to current and future V/C

Safety Needs

The Safety Performance Area is an emphasis area for I-10/SR 85. Ten of fourteen segments of the I-10/SR 85 corridor exhibit needs in Safety Performance. Five of the fourteen segments have High level of need. Safety needs by segment and the milepost of crash location are summarized below with the key characteristics that exceed statewide average.

- Segment 10-3 MP 22-32 *13 Crashes; 3 Fatal*
  - 54% Involve overturning
  - 38% Involve collision with motor vehicle
  - 54% Involve speed too fast for conditions
- Segment 10-4 MP 32-54 37 *Crashes; 13 Fatal*
  - 57% Involve overturning
  - 76% Involve single vehicle
  - 57% Involve speed too fast for conditions
- Segment 10-5 MP 54-71 *26 Crashes; 9 Fatal*
  - 35% Involve collision with motor vehicle
  - 27% Involve rear end
  - 46% Involve speed too fast for conditions
- Segment 10-6 MP 71-82 18 *Crashes; 6 Fatal*
  - 72% Involve overturning
  - 22% Involve rear end
  - 22% Involve inattention/distraction
- Segment 10-7 MP 82-98 25 *Crashes; 15 Fatal*
  - 54% Involve overturning
  - 29% Involve no improper action
  - 96% Involve dry conditions
- Segment 85-9 MP 155-149 *15 Crashes; 6 Fatal*
  - 87% Involve collision with motor vehicle
  - 73% Involve angle
  - 40% Involve ran stop sign

Freight Needs

The Freight Performance Area is an emphasis area for I-10/SR 85. Thirteen of the fourteen segments of the I-10/SR 85 Corridor exhibit needs in Freight Performance. There are five segments with Medium and High level of need.

The SR 85 portion of the corridor exhibits a Freight Index need in every segment except for Segment 85-12.

Similar to Mobility, 100% of road closures are due to incidents/accidents and impact freight performance; these are summarized below which identify focus areas for the I-10/SR 85 Corridor.

- The number of closures on I-10/SR 85 due to incidents/accidents are above statewide average in the following areas:
- Segment 10-1 (MP 0-16)
- Segment 85-9 (MP 155-149)
- Segment 85-11 (MP 138-123)
- Segment 85-13 (MP 120-118)
- Segment 85-14 (MP 120-123)

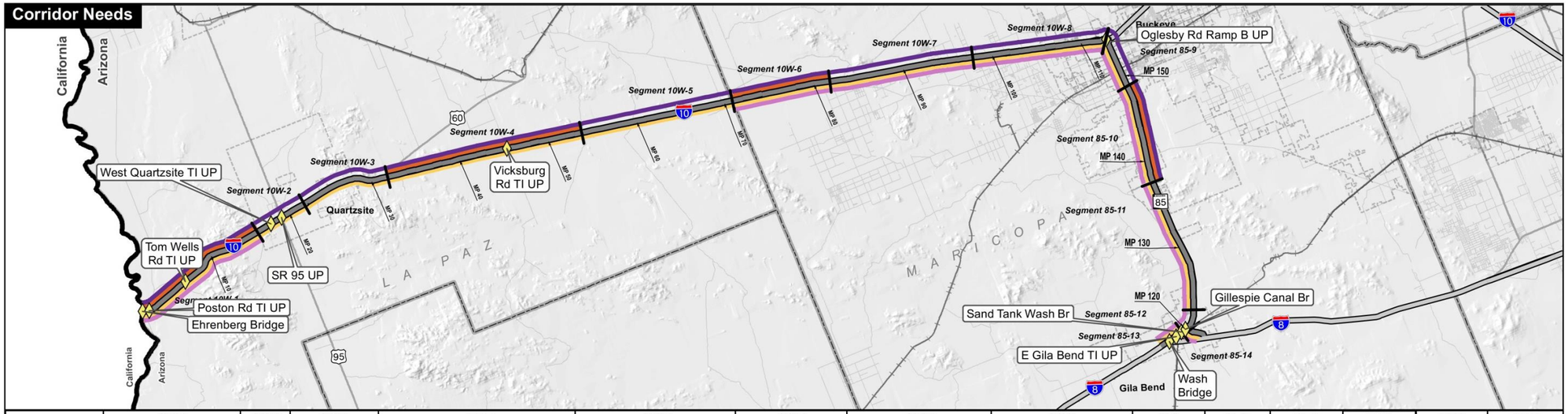
Segments 85-9, 85-10, 85-11, 85-13, and 85-14 all exhibit need in Directional PTI. Seven of the fourteen segments exhibit a need in Bridge Clearance. Bridges in Segments 10-1, 10-2, 10-3, and 10-6 indicate a medium level of need because they are below the clearance threshold of 16.25 feet, however are not considered a Hot Spot since they have ramps to allow oversize mainline traffic to avoid the bridge. The two Hot Spot Bridges are Ramsey Mine Rd UP in Segment 10-4 at MP 33.78, and 355th Ave UP in Segment 10-8 at MP 101.40. They are below the clearance threshold of 16.25 feet and do not have ramps for oversize mainline traffic to utilize.

9.2 Overlapping Needs

This section identifies overlapping performance needs on I-10/SR 85, which provides guidance to develop strategic solutions that address more than one performance area. Completing projects that address multiple needs may present the opportunity for cost savings as well as more effectively improving overall performance. The map in **Figure 8** shows the extent of overlapping needs. Overlapping needs are summarized below.

- Segment 10-1 has overlapping needs in all five performance areas. Pavement needs are impacted by failure hot spots at MP 9-11, MP 13, and MP 15. Bridge needs are impacted by the Tom Wells Rd TI UP at MP 5.84 being identified for historical review. Additionally, the Ehrenberg Bridge at MP 1.01 and Poston Rd TI UP at MP 0.62 both have ratings of 5. Mobility and Freight in Segment 10-1 are impacted by the high PTI values due to Ehrenberg POE at the Arizona/California border. Safety needs are impacted by a high percentage of fatal and incapacitating injury crashes involving SHSP top 5 Emphasis Areas Behaviors.
- Segment 10-2 has overlapping needs in Bridge, Safety, and Freight. Bridge needs are impacted by the structural rating of the West Quartzsite TI UP Bridge at MP 17.50 and the SR 95 UP at MP 18.89. Safety needs are impacted by the Safety Index and the WB Directional Safety Index. Freight is impacted by the West Quartzsite Pedestrian Overpass having low clearance, though it does have a ramp-around option for oversize mainline traffic to avoid the bridge.
- Segment 10-3 has overlapping needs in Safety and Freight. Safety needs are impacted by Safety Hot Spots at Westbound MP 25 and MP 29. Additionally, Safety needs are impacted by a high percentage of Fatal and Incapacitating Injury Crashes in the segment. Freight needs are impacted by the Brenda TI UP at MP 31.17 which does not have a ramp to allow oversize mainline traffic to avoid bridge.
- Segment 10-4 has overlapping needs in Pavement, Bridge, Safety, and Freight. Pavement needs are impacted by Failure Hot Spots at EB Mileposts 36-37, 38-45, and 47-48, and WB Mileposts 41-42, 47-48, and 51-52. Bridge needs are impacted by the structural rating of Vicksburg Road TI UP located at MP 45.34. Safety needs are impacted by Directional Safety Index and a high percentage of Fatal and Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors. Safety Hot Spots are located at WB MP 49 and EB Mileposts 35, 37, and 42. Freight needs are impacted by the Ramsey Mine Rd UP at MP 33.78, which is a Truck Height Restriction Hot Spot. Additionally, Freight needs are impacted by the high levels of Closure Duration in the EB direction.
- Segment 10-5 has overlapping needs in Safety and Freight. Safety needs are impacted by Safety Index, Directional Safety Index, and a high percentage of Fatal and Incapacitating Injury Crashes Involving Trucks. Safety Hot spots are located at EB Mileposts 61-62. Freight needs are impacted by roadway closures due to incidents or accidents, and low bridge clearance.
- Segment 10-6 has overlapping needs in Pavement, Mobility, Safety, and Freight. Pavement needs are impacted by Directional PSR and Failure Hot Spots which are located at EB Mileposts 77-79 and WB Mileposts 71-73. Mobility needs are impacted by a low level of closure frequency in the EB direction. Safety needs are impacted by the Safety Index, EB Directional Safety Index, a high percentage of Fatal and Incapacitating Injury Crashes involving SHSP Top 5 Emphasis Areas Behaviors, and a high percentage of Fatal and Incapacitating Injury Crashes Involving Trucks. Safety Hot Spots are located at WB Mileposts 70-74.Freight needs are impacted by medium and low levels of Closure Duration due to incidents or accidents, and low bridge clearance.
- Segment 10-7 has overlapping needs in Mobility, Safety, and Freight. Mobility needs are impacted by Closure frequency in the WB direction. Safety needs are impacted by the Safety Index, Directional Safety Index, and a high percentage of Fatal and Incapacitating Injury Crashes Involving Trucks. Safety Hot Spots are located at EB Mileposts 82 and 86-88. Freight needs are impacted by elevated levels of Closure Duration in the WB direction and Bridge Clearance.
- Segment 10-8 has overlapping needs in Bridge, Mobility, Safety, and Freight. Bridge needs are impacted by the structural rating of Oglesby Road Ramp Bridge UP located at MP 112.75. Mobility needs are impacted elevated levels of Future Daily V/C. Safety needs are impacted by the Safety Index, EB Directional Safety Index, a high percentage of Fatal and Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors, and a high percentage of Fatal and Incapacitating Injury Crashes Involving Trucks. Safety Hot Spots are located at EB Mileposts 107 and 109-112, and WB Mileposts 111-112. Freight needs are impacted by elevated levels of Closure Duration in the WB direction, and a Truck Height Restriction Hot Spot at the 355th Ave UP, located at MP 101.4.
- Segment 85-9 has overlapping needs in Mobility, Safety, and Freight. Mobility needs are impacted by elevated Closure Frequencies in the SB direction, elevated PTI in the SB direction, and an at-grade railroad crossing at MP 151 causing delays. Freight needs are impacted by elevated Freight Index, elevated Directional PTI, and elevated Closure Duration in the SB direction.
- Segment 85-10 has overlapping needs in Pavement, Mobility, Safety, and Freight. Pavement needs are impacted by Failure Hot Spots located at NB Mileposts 143-146. Mobility Needs are impacted by elevated PTI in the NB direction. Safety needs are impacted by SB Safety Index. Freight needs are impacted by Freight Index, elevated PTI in the NB direction, and elevated Closure Duration in the NB direction.
- Segment 85-11 has overlapping needs in Mobility and Freight. Mobility needs are impacted by elevated PTI in the SB Direction. Freight needs are impacted by Freight Index and elevated PTI in the SB direction.
- Segment 85-12 has overlapping needs in Bridge and Mobility. Bridge needs are impacted by the structural evaluation of Gillespie Canal Bridge at MP 120.25. Mobility needs are impacted by Mobility Index due to Current and Future V/C, and high level of need in Bicycle Accommodation due to shoulder widths.
- Segment 85-13 has overlapping needs in Mobility and Freight. Mobility needs are impacted by elevated scores due to Current and Future V/C, elevated TTI and PTI scores, and Bicycle Accommodation showing a higher level of need due to shoulder widths.

Figure 8: Summary of Needs and Programmed Projects: I-10/SR 85



Segment Number and Mileposts	10W-1	10W-2	10W-3	10W-4	10W-5	10W-6	10W-7	10W-8	85-9	85-10	85-11	85-12	85-13	85-14
	MP 0 - 16	MP 16 - 22	MP 22 - 32	MP 32 - 54	MP 54 - 71	MP 71 - 82	MP 82 - 98	MP 98 - 113	MP 155 - 149	MP 149 - 138	MP 138 - 123	MP 123 - 120	MP 120 - 118	MP120 - 123
Average Need	1.38	0.62	0.85	1.23	0.92	1.31	1.15	1.08	1.91	0.85	0.82	1.30	1.60	1.80

10.0 NEXT STEPS

The principal objective of the corridor profile study is to identify strategic solutions (investments) that are performance-based to ensure that available funds maximize the performance of the State's most strategic transportation corridors.

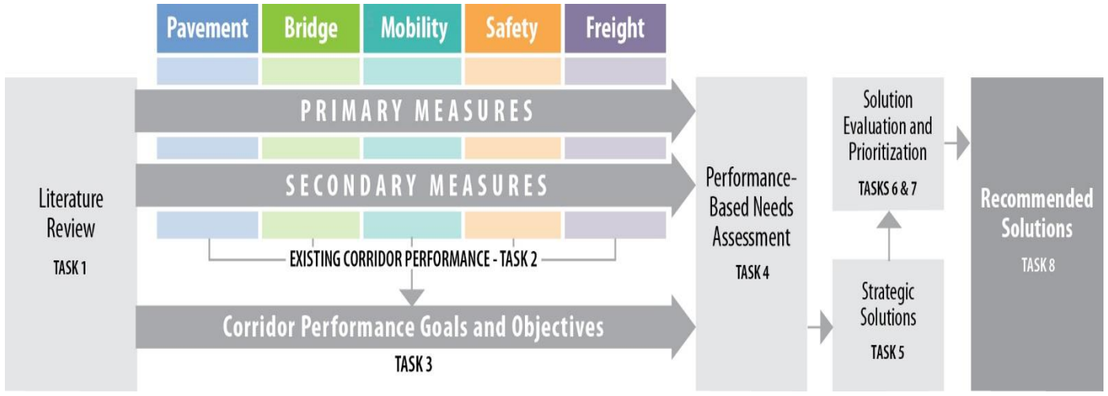
The actionable performance needs documented in Working Paper 4 will serve as a foundation for developing strategic investments for corridor preservation, modernization, and expansion. Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes where various candidate projects are developed for consideration in programming in the P2P Link process. Rather, strategic investments are intended to complement ADOT's traditional project development processes with non-traditional projects to address performance needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments will be considered along with other candidate projects in the ADOT programming process.

Illustrative examples of strategic investments are:

- *Projects that address significant performance needs.* Projects that address a Medium or High performance need identified in the corridor profile study that have a high probability to significantly improve corridor performance may be identified as strategic investments. These projects may include a project in the current program, a planned project not in the current program, or a new project recommended in the corridor profile study.
- *Projects that address needs in multiple performance areas.* For example, a single project to rehabilitate the roadway pavement surface and multiple bridge decks on a segment of roadway would address multiple performance areas (Pavement and Bridge) and could result in significant cost savings in traffic control (as compared to traffic control costs for separate projects to rehabilitate pavement surface and bridge decks). Another example would be that a travel lane pavement rehabilitation project could be expanded to include shoulder rehabilitation and rumble strip construction to reduce road departure safety needs.
- *Projects that address repetitive issues.* For example, if there is a history of high levels of maintenance activities at a particular bridge or segment of pavement, there may be an underlying need that, if addressed properly, will reduce the need for future maintenance. Higher-cost strategic capital investments to correct repetitive maintenance issues can result in life cycle cost savings by reducing maintenance costs over time.
- *Phased projects that achieve a long-term improvement objective.* For example, a life cycle cost analysis may recommend total pavement reconstruction to address a subgrade failure; however the cost of reconstruction may not be feasible from a funding perspective. A strategic investment may be recommended to extend the life of the current pavement infrastructure until funding availability allows for full pavement reconstruction.
- *Projects that utilize innovative solutions to extend the operational life of infrastructure or improve performance.* Innovative solutions that modernize a segment of roadway may be identified as strategic investments. Examples of modernization activities include widening of shoulders, access control, and replacement/enhancement of infrastructure to address obsolescence, hazard elimination, and the application of various traffic control and management technologies to improve traffic flow at a lower cost than traditional expansion solutions.

Strategic investments will be developed in Task 5 of the corridor profile study to address specific performance needs on I-10/SR 85. In addition, meetings will be conducted with ADOT staff to discuss alternatives for addressing infrastructure performance needs that can be evaluated through a systematic analysis of life cycle costs and risks. **Figure 9** shows the tasks in the Corridor Profile Study process.

Figure 9: Corridor Profile Study Process



APPENDIX A: METHODOLOGIES FOR DETERMINING PERFORMANCE AREA NEEDS (STEPS 1-3)

Pavement Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Pavement Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Pavement. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregate Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Facility Type".

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Pavement is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the segment information and the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the "Hot Spots" column any pavement failure hot spots identified as part of the baseline corridor performance. For each entry, include the milepost limits of the hot spot. Hot spots are identified in the Pavement Index spreadsheet by the red cells in the columns titled "% Pavement Failure". These locations are based on the following criteria:

Interstates: IRI > 105 or Cracking > 15

Non-Interstates: IRI > 142 or Cracking > 15

Every segment that has a % Pavement Failure greater than 0% will have at least one hot spot. Hot spot locations should be described as extending over consecutive miles. For example, if there is a pavement failure location that extends 5 consecutive miles, it should be identified as one hot spot, not 5 separate hot spots.

Step 2.3

Identify recently completed or under construction paving projects in the "Previous Projects" column. Include only projects that were completed after the pavement condition data period (check dates in pavement condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.5

Update the "Final Need" column using the following criteria:

- If "None" but have a hot spot (or hot spots), the Final Need = Low, and note the reason for the change in the "Comments" column (column H).

- If a recent project has superseded the performance rating data, change the Final Need to "None" and note the reason for the change in the "Comments" column.

Example Scales for Level of Need

Performance Thresholds		Initial Need	Description
3.75		None	(>3.57)
		Low	Middle 1/3rd of Fair Perf. (3.38 - 3.57)
3.2		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (3.02-3.38)
		High	Lower 2/3rd of Poor Performance (<3.02)

Need Scale for Interstates

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.57	3.38	3.38	3.02	3.02
Pavement Index (corridor emphasis area)	3.93	3.57	3.57	3.20	3.20
Pavement Index (segments)	3.57	3.38	3.38	3.02	3.02
Directional PSR	3.57	3.38	3.38	3.02	3.02
%Pavement Failure	10%	15%	15%	25%	25%

Need Scale for Highways (Non-Interstates)

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.30	3.10	3.10	2.70	2.70
Pavement Index (corridor emphasis area)	3.70	3.30	3.30	2.90	2.90
Pavement Index (segments)	3.30	3.10	3.10	2.70	2.70
Directional PSR	3.30	3.10	3.10	2.70	2.70
%Pavement Failure	10%	15%	15%	25%	25%

Step 2.6

Note any programmed projects that could have the potential to mitigate pavement needs in in the "Comments" column. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the "Comments" column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input the level of historical investment for each segment. This will be determined from the numeric score from the Pavement History Table based on the following thresholds:

- Low = < 4.60
- Medium = 4.60 – 6.60
- High = > 6.60

If the PeCoS data shows a high level of maintenance investment, increase the historical investment rating by one level.

Step 3.2

Note the milepost ranges of pavement failure hot spots into the column titled "Contributing Factors and Comments."

Step 3.3

Note any other information that may be contributing to the deficiency, or supplemental information, in the "Contributing Factors and Comments" column. This could come from discussions with ADOT District staff, ADOT Materials/Pavement Group, previous reports, or the historical investment data.

Step 3.4

Include any programmed projects from ADOT's 5-year construction program in the "Contributing Factors and Comments" column.

Bridge Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Bridge Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Bridge. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial level of need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Number of Bridges."

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/WP#2 into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Bridge is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 .The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the column titled "Hot Spots" any bridge hot spots identified as part of the baseline corridor performance. For each entry, note the specific location. Hot spots are identified as having any bridge rating of 4 or less, or multiple ratings of 5 in the deck, substructure, or superstructure ratings.

Step 2.3

Identify recently completed or under construction bridge projects in the "Previous Projects" column. Include only projects that were completed after the bridge condition data period (check dates in bridge condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.4

Update the Final Need on each segment based on the following criteria:

- If the Initial Need is "None" and there is at least one hot spot located on the segment, change the Final Need to "Low".
- If a recent project has superseded the performance rating data, the performance data should be adjusted to increase the specific ratings and the resulting need should be reduced to account for the project.
- Note the reason for any change in the "Comments" column.

Step 2.5

Historical bridge rating data was tabulated and graphed to find any bridges that had fluctuations in the ratings. Note in the "Historical Review" column any bridge that was identified as having a potential historical rating concern based on the following criteria:

- Ratings increase or decrease (bar chart) more than 2 times
- Sufficiency rating drops more than 20 points

This is for information only and does not affect the level of need.

Step 2.6

Note the number of functionally obsolete bridges in each segment in the column titled "# Functionally Obsolete Bridges". This is for information only and does not affect the level of need.

Step 2.7

Identify each bridge "of concern" in the "Comments" column. Note any programmed projects that could have the potential to mitigate bridge needs. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the "Comments" column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Example Scales for Level of Need

Bridge Index Performance Thresholds	Level of Need		Description
6.5	Good	None	All of Good Performance and upper 1/3rd of Fair Performance
	Good		
	Good		
	Fair		
	Fair	Low	Middle 1/3rd of Fair Performance
5.0	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
	Poor		
	Poor	High	Lower 2/3rd of Poor Performance
	Poor		

Need Scale

Measure	None >=	Low >=	> Medium <		High <=
Bridge Index (corridor non-emphasis area)	6.0	5.5	5.5	4.5	4.5
Bridge Index (corridor emphasis area)	7.0	6.0	6.0	5.0	5.0
Bridge Index (segments)	6.0	5.5	5.5	4.5	4.5
Bridge Sufficiency	70	60	60	40	40
Bridge Rating	6.0	5.0	4.0	4.0	3.0
%Functionally Obsolete Bridges	21.0%	31.0%	31.0%	49.0%	49.0%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input the bridge name, structure number, and milepost information for each bridge "of concern" resulting from Step 2.

Step 3.2

For bridges that have a current rating of 5 or less, enter the specific rating, or state "No current ratings less than 6".

Step 3.3

For bridges that were identified for a historical review (step 2.5), state "Could have a repetitive investment issue". If a bridge was not identified for a historical review, state "This structure was not identified in historical review".

Step 3.4

Input any programmed projects from ADOT's 5-year construction program. Note any other information that may be contributing to the deficiency, or supplemental information. This could come from discussions with ADOT District staff, ADOT Bridge Group, or previous reports.

Mobility Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Mobility Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Refined Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns from Task 2/Working Paper #2. This includes the primary and secondary measures for Mobility. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" in the Step 1 tab.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Input the accurate number of segments for your corridor in the column titled 'Segment' and the appropriate segment milepost limits and segment lengths in adjacent columns.

Step 1.2

Select the appropriate 'Environment Type' and 'Facility Operation Type' from the drop down menus as defined in Task 2 - Existing Performance Analysis.

Step 1.3

Select 'Yes' or 'No' form the drop down list to not if the Mobility Performance Area is an Emphasis Area for your corridor.

Step 1.4

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2/Working Paper #2. Copy the performance score for each segment to the appropriate "Performance Score" column.

Step 1.5

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial deficiencies from the Step 1 template to the Step 2 template.

Step 2.2

Identify recently completed or under construction projects that would be considered relevant to mobility performance. Include only projects that were constructed after 2014 for which the 2014 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2014 that has the potential to mitigate a mobility issue on a corridor segment should be listed in the template. Such projects should include the construction of new travel lanes or speed limit changes on the main corridor only. Do not include projects involving frontage roads or crossings as they would not impact the corridor level performance.

Step 2.3

Update the Final Need using the following criteria:

- If a recent project has superseded the performance rating data and it is certain the project addressed the deficiency, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current deficiency rating and note the uncertainty as a comment.

Step 2.4

Note any programmed or planned projects that have the potential to mitigate any mobility needy on the segment. Programmed and Planned projects are provided as information and do not impact the deficiency rating. Future projects will be reviewed in the development of solution sets for identified needs and deficiencies. The source of future projects can be found in ADOT's 5-year construction program or other planning documents. Other comments relevant to the needs analysis can be entered.

Example Scales for Level of Need

Performance Thresholds	Initial Need		Description
0.71		None	(<0.77)
		Low	Middle 1/3rd of Fair Perf. (0.77 - 0.83)
0.89		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (0.83-0.95)
		High	Lower 2/3rd of Poor Performance (>0.95)

Needs Scale

Measure		None <=	Low >=	> Medium <		High <=
Mobility Index (Corridor Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Corridor Non-Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Segment)	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Future Daily V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Existing Peak hour V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Closure Extent		0.35	0.49	0.49	0.75	0.75
Directional TTI	Uninterrupted	1.21	1.27	1.27	1.39	1.39
	Interrupted	1.53	1.77	1.77	2.23	2.23
Directional PTI	Uninterrupted	1.37	1.43	1.43	1.57	1.57
	Interrupted	4.00	5.00	5.00	7.00	7.00
Bicycle Accommodation		80%	70%	70%	50%	50%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input data from Mobility Index worksheet and corridor observations in appropriate columns for Roadway Variables.

Step 3.2

Input traffic variable data in appropriate columns as indicated, Buffer Index scores will auto populate.

Step 3.3

Input relevant mobility related infrastructure located within each segment as appropriate

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for 2009-2013 on ADOT's 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. For example, the border patrol check point in Segment 3 of I-19 is a non-actionable condition.

Step 3.6

Considering all information input, identify and list the contributing factors to the Final Need score.

Safety Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Safety Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the corridor characteristics and existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for safety. As each performance score is input into the template, the Level of Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the corridor characteristics information. This includes segment operating environments and segment length. Also specify if the safety performance area is an emphasis area as determined in Task 3. The "Level of Need" is dependent on the input of the operating environment and "Emphasis Area" as the thresholds dynamically update accordingly.

Input the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score (paste values only) for each segment to the appropriate "Performance Score" column and conditional formatting should color each cell green, yellow, or red based on the corresponding performance thresholds.

Step 1.2

The thresholds for the corridor safety index are based on the segments' operating environments. To ensure that the correct corridor safety index threshold is applied, input the unique segment operating environments that exist with the corridor. Once the input is complete, the average of the Good/Fair and Fair/Poor thresholds for each of the operating environments is calculated and the "Level of Need" thresholds will be derived and applied to the main Step 1 Table.

Step 1.3

Confirm that the following criteria for "Insufficient Data" have been applied and that the resulting Level of Need has been shown as "N/A" where applicable.

- Crash frequency for a segment is less than 5 crashes over the 5-year crash analysis period.
- The change in +/- 1 crash results in the change of need level of 2 levels (i.e., changes from Good to Poor or changes from Poor to Good).
- The average segment crash frequency for the overall corridor (total fatal plus incapacitating injury crash frequency divided by the number of corridor segments) is less than 2 per segment over the 5-year crash analysis period.

Step 1.4

Confirm that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the Step 2 template**.**

Step 2.2

Using the crash concentration (hot spot) map developed as part of the baseline corridor performance, note the direction of travel and approximate milepost limits of each hot spot.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to safety performance. Include only projects that were not taken into account during the crash data analysis period (2009 – 2013). Any completed or under construction roadway project after 2013 that has the potential to mitigate a safety issue on a corridor segment should be listed in the

template. Sources of recent or current project activity can include ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need based on the following criteria:

- If there is a crash hot spot concentration on a “None” segment, upgrade the need rating to “Low.”

Step 2.5

Note any programmed projects that could have the potential to mitigate any safety need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT’s 5-year construction program. Any other relevant issues identified in previous reports should also be reported.

Needs Scale

Measure		None <=	Low <=	< Medium >		High >=	Good/Fair Threshold	Fair/Poor Threshold
Corridor Safety Index (Emphasis Area)		Weighted average based on operating environment type						
Corridor Safety Index (Non-Emphasis Area)		# Weighted average based on operating environment type					#DIV/0!	#DIV/0!
Safety Index and Directional Safety Index (Segment)	2 or 3 Lane Undivided Highway	0.98	1.02	1.02	1.10	1.10	0.94	1.06
	2 or 3 or 4 Lane Divided Highway	0.92	1.07	1.07	1.38	1.38	0.77	1.23
	4 or 5 Lane Undivided Highway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
	6 Lane Highway	0.85	1.14	1.14	1.73	1.73	0.56	1.44
	Rural 4 Lane Freeway with Daily Volume < 25,000	0.91	1.09	1.09	1.45	1.45	0.73	1.27
	Rural 4 Lane Freeway with Daily Volume > 25,000	0.89	1.1	1.1	1.53	1.53	0.68	1.32
	Urban 4 Lane Freeway	0.93	1.07	1.07	1.35	1.35	0.79	1.21
	Urban or Rural 6 Lane Freeway	0.94	1.06	1.06	1.3	1.3	0.82	1.18
	Urban > 6 Lane Freeway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
% of Fatal + Incap. Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	2 or 3 Lane Undivided Highway	53%	55%	55%	59%	59%	51%	57%
	2 or 3 or 4 Lane Divided Highway	47%	50%	50%	57%	57%	44%	54%
	4 or 5 Lane Undivided Highway	45%	48%	48%	54%	54%	42%	51%
	6 Lane Highway	39%	43%	43%	50%	50%	35%	46%
	Rural 4 Lane Freeway with Daily Volume < 25,000	46%	49%	49%	56%	56%	43%	53%
	Rural 4 Lane Freeway with Daily Volume > 25,000	46%	51%	51%	62%	62%	41%	57%
	Urban 4 Lane Freeway	52%	55%	55%	62%	62%	49%	59%
	Urban or Rural 6 Lane Freeway	42%	50%	50%	65%	65%	34%	57%
	Urban > 6 Lane Freeway	47%	51%	51%	59%	59%	43%	55%
% of Fatal + Incap. Injury Crashes Involving Trucks	2 or 3 Lane Undivided Highway	6%	7%	7%	8%	8%	5%	7%
	2 or 3 or 4 Lane Divided Highway	5%	6%	6%	8%	8%	4%	7%
	4 or 5 Lane Undivided Highway	7%	8%	8%	11%	11%	6%	10%
	6 Lane Highway	3%	6%	6%	12%	12%	0%	9%
	Rural 4 Lane Freeway with Daily Volume < 25,000	14%	15%	15%	18%	18%	13%	17%
	Rural 4 Lane Freeway with Daily Volume > 25,000	9%	11%	11%	15%	15%	7%	13%
	Urban 4 Lane Freeway	8%	9%	9%	12%	12%	7%	11%
	Urban or Rural 6 Lane Freeway	8%	10%	10%	13%	13%	6%	11%
	Urban > 6 Lane Freeway	4%	5%	5%	7%	7%	3%	6%
% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	2 or 3 Lane Undivided Highway	22%	25%	25%	30%	30%	19%	27%
	2 or 3 or 4 Lane Divided Highway	19%	22%	22%	29%	29%	16%	26%
	4 or 5 Lane Undivided Highway	7%	8%	8%	10%	10%	6%	9%
	6 Lane Highway	7%	14%	14%	27%	27%	0%	20%
	Rural 4 Lane Freeway with Daily Volume < 25,000	6%	7%	7%	9%	9%	5%	8%
	Rural 4 Lane Freeway with Daily Volume > 25,000	11%	14%	14%	20%	20%	8%	17%
	Urban 4 Lane Freeway	10%	11%	11%	13%	13%	9%	12%
	Urban or Rural 6 Lane Freeway	9%	11%	11%	15%	15%	7%	13%
	Urban > 6 Lane Freeway	15%	17%	17%	22%	22%	13%	20%
% of Fatal _ Incapacitating Injury Crashes Involving Non-Motorized Travelers	2 or 3 Lane Undivided Highway	3%	4%	4%	5%	5%	2%	4%
	2 or 3 or 4 Lane Divided Highway	3%	4%	4%	5%	5%	2%	4%
	4 or 5 Lane Undivided Highway	6%	7%	7%	9%	9%	5%	8%
	6 Lane Highway	11%	14%	14%	20%	20%	8%	17%
	Rural 4 Lane Freeway with Daily Volume < 25,000	2%	2%	2%	3%	3%	1.7%	2.5%
	Rural 4 Lane Freeway with Daily Volume > 25,000	0%	0%	0%	0%	0%	0%	0%
	Urban 4 Lane Freeway	7%	9%	9%	12%	12%	5%	10%
	Urban or Rural 6 Lane Freeway	3%	5%	5%	9%	9%	1%	7%
	Urban > 6 Lane Freeway	1%	1%	1%	2%	2%	0.5%	1.5%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

Table 3 - Step 3 Template

A separate *Crash Summary Sheet* file contains summaries for 8 crash attributes for the entire corridor, for each corridor segment, and for statewide roadways with similar operating environments (the database of crashes on roadways with similar operating environments was developed in Task 2 (the baseline corridor performance)). The crash attribute summaries are consistent with the annual ADOT Publication, *Crash Facts*. The 8 crash attribute summaries consist of the following:

- First Harmful Event (FHET)
- Crash Type (CT)
- Violation or Behavior (VB)
- Lighting Condition (LC)
- Roadway Surface Type (RST)
- First Unit Event (FUE)
- Driver Physical Condition (Impairment)
- Safety Device Usage (Safety Device)

Non-colored tabs in this spreadsheet auto-populate with filtered crash attributes. Each tab is described below:

- **Step_3_Summary** – This tab contains the filtered summary of crashes that exceed statewide thresholds for crashes on roadways with similar operating environments. Data in this tab are copied into the Step 3 template.
- **Statewide** – This tab contains a summary of statewide crashes from roadways with similar operating environments filtered by the 8 crash type summaries listed above. The crash type summaries calculate statewide crash thresholds (% total for fatal plus incapacitating crashes). The crash thresholds were developed to provide a statewide expected proportion of crash attributes against which the corridor segments' crash attributes can be compared. The crash thresholds were developed using the *Probability of Specific Crash Types Exceeding a Threshold Proportion* as shown in the Highway Safety Manual, Volume 1 (2010). The thresholds are automatically calculated within the spreadsheet. The threshold proportion was calculated as follows:

$$p*_i = \frac{\sum N_{Observed,i}}{\sum N_{Observed,i(total)}}$$

Where:

$p*_i$ = Threshold proportion

$\sum N_{Observed,i}$ = Sum of observed target crash frequency within the population

$\sum N_{Observed,i(total)}$ = Sum of total observed crash frequency within the population

A minimum crash sample size of 5 crashes over the 5-year crash analysis period is required for a threshold exceedance to be displayed in the Step 3 template. The probability of exceeding the crash threshold was not calculated to simplify the process.

- **Corridor** – A summary of corridor-wide crashes filtered by the 8 crash attribute summaries listed above.
- **Segment FHET** – A segment-by-segment summary of crashes filtered by first harmful event attributes.
- **Segment CT** – A segment-by-segment summary of crashes filtered by crash type attributes.
- **Segment VB** - A segment-by-segment summary of crashes filtered by violation or behavior attributes.
- **Segment LC** – A segment-by-segment summary of crashes filtered by lighting condition attributes.
- **Segment RST** – A segment-by-segment summary of crashes filtered by roadway surface attributes.
- **Segment FUE** – A segment-by-segment summary of crashes filtered by first unit event attributes.
- **Segment Impairment** – A segment-by-segment summary of crashes filtered by driver physical condition attributes related to impairment.
- **Segment Safety Device** – A segment-by-segment summary of crashes filtered by safety device usage attributes.

The steps to compete Step 3 include:

Step 3.1

Using the Crash_Summary_Sheet.xlsx, go to the "Step_3_Summary" tab. Input the operating environments for each segment in the table.

Step 3.2

Filter data from the ADOT database for the "CORRIDOR_DATA" tab by inserting the following data in the appropriate columns that are highlighted in gray for the "INPUT_CORRIDOR_DATA" tab:

- Incident ID
- Incident Crossing Feature (MP)
- Segment Number (Non-native ADOT data – must be manually assigned based on the location of the crash)

- Operating Environment (Non-native ADOT data – should already be assigned but if for some reason it isn't, it will need to be manually assigned)
- Incident Injury Severity
- Incident First Harmful Description
- Incident Collision Manner
- Incident Lighting Condition Description
- Unit Body Style
- Surface Condition
- First Unit Event Sequence
- Person Safety Equipment
- Personal Violation or Behavior
- Impairment

Note that columns highlighted in yellow perform a calculated input to aggregate specific crash descriptions. For example, crashes can contain various attributes for animal-involved crashes. The crash attributes that involve an animal were combined into a common attribute, such as "ANIMAL". This will allow the summaries to be consistent with the ADOT *Crash Facts*.

The data in the Impairment category contains blank descriptions if it was found that there was "No Apparent Influence" or if it was "Unknown". Using the crash data fields "PersonPhysicalDescription" 0 - 99, fill in the blank columns to reflect if the physical description is described as "No Apparent Influence" or "Unknown". Note that the native physical description data from the ADOT database may need to be combined to a single column.

Step 3.3

Confirm that the crash database is being properly filtered by comparing crash frequencies from the summary tables with the frequencies developed in Task 2. For example, the lookup function will fail if the filter is for "NO IMPROPER ACTION" if the database has the attribute of "NO_IMPROPER_ACTION".

Step 3.4

Copy and paste the Step_3_Summary into the Task 4 – Safety Needs Assessment spreadsheet in the Step 3 tab. Paste values only and remove the summaries with "0%s" for a clean display. Where duplicate values exist, go to the "Calcs" tab in the Crash_Summary_Sheet file to determine which categories have the same %. If there are more crash types with the same % than there is space in the table, select the crash type with the highest difference between the segment % and the statewide average %

Step 3.5

The Step 3 table in the Task 4 – Safety Needs Assessment spreadsheet should be similar to the Step 3 template. In the Segment Crash Summaries row, the top three crash attributes are displayed. Change the font color of the crash attributes that exceed the statewide crash threshold to red for emphasis. The attributes with a red font in the "Calcs" tab have exceeded statewide crash thresholds. Note that corridor-wide values are not compared to statewide values as corridor-wide values are typically a blend of multiple similar operating environments while the statewide values apply to one specific similar operating environment.

Step 3.6

Provide a summary of any observable patterns found within the crash Hot Spots, if any exist in the segments.

Step 3.7

Input any historic projects (going no further back than 2000) that can be related to improving safety. Projects more than five years old may have exceeded their respective design life and could be contributing factors to safety performance needs.

Step 3.8

Input key points from District interviews or any important information from past discussions with District staff that is consistent with needs and crash patterns identified as part of the performance and needs assessment as this may be useful in identifying contributing causes. This information may be obtained from District Maintenance personnel by requesting the mile post locations that may be considered safety issues.

Step 3.9

For segments with one or more of the following characteristics, review crashes of all severity levels (not just fatal and incapacitating injury crashes). Identify likely contributing factors and compare that to the above statewide average comparison findings already calculated for fatal and incapacitating injury crashes. Refine the contributing factors list accordingly.

- Segments with Medium or High need
- Segments with a crash hot spot concentration (but only review crashes at the concentration areas)
- Segments with no apparent predominant contributing factors based on the comparison of fatal and incapacitating crashes to statewide averages if the segment has a Medium or High need.

Step 3.10

Considering all information in Steps 1-3, list the contributing factors using engineering judgment and the information on contributing factors available in Section 6.2 of the 2010 Highway Safety Manual. Additional sources for determining contributing factors may include aerial, "streetview", and/or ADOT photologs. Other documents such as Design Concept Reports (DCR) or Road Safety Assessments can provide insight into the study corridor's contributing factors.

Add comments as needed on additional information related to contributing factors that may have been provided by input from ADOT staff.

Freight Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Freight Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score and color for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Freight. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted score, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Task 2. Copy the performance score for each segment to the appropriate "Performance Score" column. Select the *Facility Operations* for each segment from the drop-down list and input whether or not the performance area is an emphasis area. The corridor needs assessment scales will be updated automatically.

Step 1.2

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial need from the Step 1 template to the Step 2 template.

Step 2.2

Note any truck height restriction hot spots (clearance < 16') identified as part of the baseline corridor performance. For each entry, note the milepost of the height restriction and if the height restriction can be detoured by ramping around the obstruction. If it is not possible for a truck to ramp around the height restriction, note the existing height as well.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to freight performance. Include only projects that were not taken into account during the freight data analysis period. Any completed or under construction roadway project after the date of the data that has the potential to mitigate a freight issue on a corridor segment should be listed in the template. Such projects can include the construction of climbing lanes or Dynamic Message Signs (DMS) installation. Sources of recent or current project activity can be ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need using the following criteria:

- If there is one or more truck height restriction hot spots where a truck cannot ramp around on a 'None' segment, increase (i.e., worsen) the need rating to 'Low'.
- If a recent project has superseded the performance rating data and it is certain the project addressed the need, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current need rating and note the uncertainty as a comment.

Step 2.5

Note any programmed projects that could have the potential to mitigate any freight need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis, they can be entered in the right-most column.

Example Scales for Level of Need - Freight Index

Performance Score Thresholds	Performance Level	Initial Performance Level of Need	Description (Non-emphasis Area)
	Good	None	All levels of Good and the top third of Fair (>0.74)
	Good		
0.77	Good		
0.74	Fair		
0.70	Fair	Low	Middle third of Fair (0.70-0.74)
0.67	Fair	Medium	Lower third of Fair and top third of Poor (0.64-0.70)
0.64	Poor		
	Poor	High	Lower two-thirds of Poor (<0.64)
	Poor		

Needs Scale

Measure	None >=	> Low <	> Medium <	High <=
Corridor Freight Index (Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments			
Corridor Freight Index (Non-Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments			
Freight Index (Segment)				

Measure	None >=	> Low <		> Medium <		High <=
Interrupted	0.28	0.28	0.22	0.22	0.12	0.12
Uninterrupted	0.74	0.74	0.70	0.70	0.64	0.64
Measure	**None <=**	**< Low >**		**< Medium >**		**High >=**
Directional TTI						
Interrupted	1.53	1.53	1.77	1.77	2.23	2.23
Uninterrupted	1.21	1.21	1.27	1.27	1.39	1.39
Directional PTI						
Interrupted	4.00	4.00	5.00	5.00	7.00	7.00
Uninterrupted	1.37	1.367	1.43	1.43	1.57	1.57
Closure Duration						
All Facility Operations	71.07	71.07	97.97	97.97	151.75	151.75
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Bridge Clearance (feet)						
All Bridges	16.33	16.33	16.17	16.17	15.83	15.83

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

The steps to compete Step 3 include:

Step 3.1

Input all roadway variable data that describe each segment into the appropriate columns. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.2

Input all traffic variables for each segment into the appropriate columns. The Buffer Index will auto populate based on the TPTI and TTTI input in the Step 1 tab. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.3

Input any freight-related infrastructure that currently exists on the corridor for each segment. The relevant infrastructure can include DMS locations, weigh stations, Ports of Entry (POE), rest areas, parking areas, and climbing lanes. Include the mileposts of the listed infrastructure. This data can be extracted from the most recent Highway Log and the 2015 Climbing and Passing Lane Prioritization Study.

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for the analysis period on ADOT's 11 designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Closures (No Reason)
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. Examples of Non-Actionable conditions can include border patrol check points and other closures/restrictions not controlled by ADOT. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Task 4.

Step 3.6

Input any programmed and planned projects or issues that have been identified from previous documents or studies that are relevant to the Final Need. Sources for this data include the current Highway Log, the 2015 Climbing and Passing Lane Prioritization Study, and ADOT's 5-year construction program.

Step 3.7

Considering all information in Steps 1-3, identify the contributing factors to the Final Need column. Potential contributing factors to freight performance needs include roadway vertical grade, number of lanes, traffic volume-to-capacity ratios, presence/lack of a climbing lanes, and road closures. Also identify higher than average percentages of one or more closure reasons on any given segment